SAVING AND INVESTMENT

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THE THEORY OF CAPITAL IN A DEVELOPING COMMUNITY

By

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PREFACE

This work is an experiment in developing a line of thought which in its essence is in full harmony with traditional English economic theorizing but when pursued with uncompromising rigour is found to lead to conclusions that sharply conflict with certain generally accepted dogmas with regard to capital and saving.

In Professor Pigou's recent work, *The Economics of Stationary States*, I found a method that cleared away many confusions of thought, and at the same time suggested to me the need of an analogous treatment of the problem of development. For it seemed clear that, if the conditions of equilibrium in any stationary state can be rigidly shown, there must also be a possibility of a similarly rigid treatment of the problems of transition from any given state to a stationary one. If any assumption can be made about human behaviour in any particular set of external conditions that implies the endless repetition through time of a certain form of economic behaviour (such as to present us with the phenomena of a stationary state) then the same assumption about human behaviour in a non-stationary state clearly necessitates a determinate progression in economic behaviour that culminates in the achievement of the stationary state. If we call the repetitiveness through time of the stationary state an equilibrium, then the progression through time towards the stationary state may also be described as a form of equilibrium, with progression substituted for repetition; and whatever suffices to explain stationariness must also suffice to explain development and the precise rate of development; so that stationariness becomes the limiting case of development, in which situations that

succeed one another in time happen to be identical. In postulating, therefore, a stationary state, we are necessarily assuming that there is some tendency in human behaviour which, in any conditions other than those assumed, would give development, since repetition constitutes the limit between positive and negative development. This tendency arises out of the prospectiveness characteristic of human behaviour; but in Pigou's treatment it is assumed that this prospectiveness is combined with a certain discrimination against the future.

The idea that this prospectiveness, particularly in a highly capitalistic stationary community, must involve something reasonably to be described as abstinence is mainly responsible for certain conclusions, both of the orthodox school and of the unorthodox school represented by Mr. Keynes, that now appear to me to be untenable. If a state has become stationary, time has ceased to be scarce, as is shown by the fact that there is constant repetition. There is nothing to be gained by economizing in time or by wasting time ("waiting"); and, therefore, there is no true saving. We are only prompted to wait when we can gain something by waiting—when, in other words, we can move to a new state of affairs which is more satisfactory. The scarcity of time, under these conditions, reveals itself in the process of development to the new situation, which takes time instead of being reached by a single leap at the moment when the possibility of the new situation reveals itself (like electrons, that find themselves in new orbits without the necessity of passing from one orbit to another). Time, therefore, acquires value; and hence the emergence of saving and interest. But the nearer we are to a stationary state (the larger the consumable income and the larger the ratio of a community's capital to that consumable income), the less in general will that community save.

Yet, the opposite conclusion is frequently implied by

orthodox economists and is explicitly asserted by Mr. Keynes. At the same time they emphasize the tendency in human nature to discount the future, and hold that in an exchange community individuals will so act that the future is effectively discounted. In Chapter II an attempt is made to controvert this view ; but its acceptance or rejection does not affect the general argument of the book if, as I also argue, the presence of effective discount would demand an even greater rate of decrease of saving with increase of income than would be the case in its absence.

The assumption on which the whole theory of this book is based is simply that human beings tend to equate the marginal disutility of their labour with the marginal utility of the product, whether this product is in the present or the future and whether this future is psychologically discounted or not—a principle which does not require to be supplemented by any additional assumptions about the strength of some hypothetical propensity in human nature to save blindly for the sake of saving or to save more as the need for saving diminishes. The working out of this principle leads to a theory of capital and interest essentially similar to that of Bohm-Bawerk ; though Böhm-Bawerk and writers of the same school have reached their conclusions by less simple lines of reasoning. More particularly in the writings of Hayek (perhaps the outstanding representative of this school in England) I find conclusions identical with mine reached by a different but converging route. My acquaintance with the work of this school is, however, inadequate to justify more than these obviously superficial comparisons and contrasts ; and this must be taken to account for a paucity of references to relevant literature that would be inexcusable if this book pretended to be more than a preliminary tentative inquiry.

The first stage in its construction was the putting together of the Appendices to Chapters III and IV. In the course

of attempts to elucidate the implications of this mathematical exercise, a more complete and rounded theory of capital and interest gradually emerged. Throughout, I have laboured under the disadvantages that beset a non-mathematician in handling mathematical material, which accounts for any crudity in the devices employed.

As the book is passing through the press, my attention has been drawn to an article in the *Economic Journal*, 1928, by the late Mr. F. P. Ramsey, who, with the aid of a more complex mathematical technique, reached results which appear to confirm some at least of the conclusions here set forth.

I am greatly indebted to Mr. M. H. Dobb for his encouragement and stimulus in reading and closely criticizing the manuscript in its first inchoate form, and for valuable suggestions with regard to its arrangement. The final form of the book owes much to the intensive criticism, both of the detailed reasoning and of its literary presentation, of Mr. L. Alston. For shortcomings that remain the sole responsibility is mine.

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CHAPTER I

ECONOMIC EQUILIBRIUM THROUGH TIME

All that is significant and vital in the concept of Waiting (as the equivalent of Capital) belongs to the economics of the developing community, and cannot without violent wrenching of ideas outside their proper context be transferred to the study of Stationary States. Yet as the result of concealed confusions of thought the attempt thus to transfer the concept with all its misleading associations is habitually made, without adequate realization of what such an analytic device necessarily involves.

Equilibrium economics, in the more usual sense of the term, is concerned with those adjustments, of quantities of goods and their values, which come about through the causation of successive changes, the adjustments approaching nearer and nearer to a position of rest with the lapse of time. For example, a given scheme of utility-schedules for the members of a community will, on the assumption of perfect competition, lead to a stock of goods in that community becoming distributed in a precise way with precisely determined values. Any deviation from this equilibrium will become progressively less with the lapse of time, and will ultimately disappear if sufficient time is allowed to elapse.

Further, if under a given scheme of utility of goods, and a given scheme of disutility of labour, goods are brought into existence by the exercise of labour, there will be a given scheme of values and quantities of labour and goods coming into existence at any moment in the absence of new inventions, any deviation from this scheme being progressively corrected by the passage of time.

The problem remains the same, however much we complicate the situation by the introduction of natural resources other than labour, of different kinds of labour, and so on, provided that at each moment of time the motivating forces are simply the schemes of utility and disutility at each moment.

But individuals are concerned with the future as well as the present, and we may assume that there are always roundabout methods known and available for economizing labour and natural resources.

Given the more comprehensive schedules of utility and disutility required in discussing normal development,[1] there is an equilibrium of quantities and values through time, just as in the simpler case: there is a scheme of values and quantities which, if achieved, will neutralize all forces that tend to cause a departure from this position. But it is an equilibrium which differs from the simpler, in that if a deviation from equilibrium occurs there can be no progressive decrease of this deviation through time. Mistakes are irrevocable, and every deviation from equilibrium which occurs determines a new position of equilibrium throughout the future. The essence of static equilibrium is that time is available for securing it, so that it will inevitably take place if we allow enough time for the diminution of deviations. The essence of the more complicated problem of what might be called equilibrium development (which we might call the problem of dynamic equilibrium if this term had not already other meanings) is that although equilibrium always tends to be achieved, the absence of another time dimension makes it impossible for any deviation to be corrected through the lapse of time.

This fact has important consequences which must be kept in the foreground when we are attempting to lay the

[1] Throughout this book the phrase "normal development" is taken to exclude anything unforseeable, not only in the methods of satisfying desires but in the character of the desires themselves.

bases of any satisfactory theory of capital and interest, which (it is one of the main aims of this book to assert) is, in reality, the theory of an equilibrium of this developmental kind. The failure to recognize this, and the treatment of capital, for the purpose of static equilibrium analysis, as a factor of production on a par with land and labour has led to many erroneous conclusions.

The assumption of " development-equilibrium " implies, of course, that in the absence of unforeseen changes in the utility and disutility schedules of the members of a community, there would, with any initial distribution of resources, be one and only one equilibrium-development for that community—that at any given point of time there must be a determinate income,[1] a determinate total of capital, and a determinate total of labour, and so on. In other words, if we abstract from all accidents—and under accidents will be included new inventions, changes of tastes, changes of population (unless a Malthusian or some other purely economic theory of population is possible), windfalls and losses from nature, and changes in social

[1] The term " income " will be used throughout this work for wealth which is destroyed to secure an immediate utility over the shortest period of time which it is convenient to regard as indivisible, and we shall use the term a " day " to indicate such an indivisible period. We shall, in general, assume that a real day can be treated as such a " day ".

The term " capital " will be used for all forms of wealth, mature or immature, existing at any moment, and not destroyed during the period of time which includes that moment and during which " income " is received (enjoyed). It will, however, be convenient at times to be so far inconsistent as to use the term capital to cover the whole stock of wealth existing at any point of time within such a " day ". This is, of course, not the same distinction as has sometimes been drawn between capital and income—that the former is co-extensive with all space-occupying economic goods and the latter the flow of satisfactions ; such an analysis, while metaphysically perhaps the most satisfactory, is for purposes of economic analysis valueless, because the goods and the flow of satisfactions belong as it were to two different worlds and are therefore incommensurate with one another.

We shall call labour " direct " when no capital, as above defined, appears, but only wealth that is destroyed within the same day. (The limiting case is that of services directly rendered to the consumer and not, even momentarily, embodied in material form.)

organization—the whole economic future is precisely determined. But it must be remembered that since every mistake is irrevocable in the process of development, what is equilibrium from the point of view of each moment changes for every mistake that is made.

What precisely is implied by this view may be brought out by considering the case of a highly artificial Crusoe, who, starting with no resources, can apply his labour either to providing income direct or to providing a larger income by roundabout methods; this income consisting entirely of one form of homogeneous "economic cake" (to use Pigou's happy phrase).

Let us suppose that our Crusoe is so rational that he does not discount the future (in the sense of showing a psychological bias in favour of present enjoyment over future enjoyment) [1] and so irrational that he considers himself immortal and constant in his attitude to labour and income, so that on any day the marginal disutility of any given quantity of labour must be the same as that on any other day, and on any day the marginal utility of any given amount of income the same as that on any other day. Let there be only two methods of securing income; by direct labour (as defined on p. 3), whereby one unit of labour gives one unit of income; and by indirect labour, whereby one unit of labour gives one unit of capital which by the lapse of one day matures without further applications of labour into C (e.g. $\frac{c}{c-1}$) units of income. (Let us also assume that any application of labour and any receiving of income occurs, in each separate case, in one indivisible unit of time, a day.)

On the first day Crusoe is confronted with these two ways of distributing his labour, so as to yield income both for to-day and for to-morrow. On each day the problem of

[1] This is not to ignore the essence of the problem, as will be shown in the next chapter.

distributing his labour recurs; but on each day the amount of income maturing is increasing, so that eventually it becomes uneconomic for him to produce any income by direct labour at all. He has then reached a stationary state with determinate amounts of "labour", "capital", and "income," given by the necessity that the marginal disutility of his labour should remain equal to the utility of the marginal income-product of his labour.

If, in this stationary state, y_s is his daily labour, then his income is Cy_s, and, if we keep to our definition of a unit of income as that which is produced by a unit of labour directly, then—

the marginal disutility of y_s labour
$= C \times$ the marginal utility of Cy_s income.

Throughout the period in which he is moving towards this stationary state, Crusoe is dividing his labour between direct and indirect production; and if we assume that he has complete control both over the total labour he expends and over the distribution of it between the two alternatives, then if x_n is his direct labour on the nth day and y_n is his indirect labour on the nth day, we have—

the marginal disutility (of $x_n + y_n$) labour
$=$ the marginal utility of $(x_n + Cy_{n-1})$ income on account of the nth day's labour and income,

and also—

$= C^1 \times$ the marginal utility of $(Cy_n + x_{n+1})$ income on account of the nth day's labour and the $(n + 1)$th day's income.

On the day on which the stationary state is achieved x has just become zero, and therefore—

[1] If Crusoe discounted future income, in the sense of having a psychological bias in favour of present income, C would here need to be replaced by a smaller figure (see Chapter II).

marginal disutility of $(o + y_s)$ labour

$=$ marginal utility of $(o + Cy_{s-1})$ income

$= C \times$ marginal utility of $(Cy_s + o)$ income

which gives us, on the assumption that we know the utility and disutility schedules, the values of y_s and y_{s-1}.

On the day before the stationary state is achieved, we have the following equations:—

marginal disutility of $(x_{s-1} + y_{s-1})$ labour

$=$ marginal utility of $(x_{s-1} + Cy_{s-2})$ income

$= C \times$ marginal utility of $(Cy_{s-1} + o)$ income which gives us the values of x_{s-1} and y_{s-2}.

By successively giving n the values s, $s - 1, \ldots 2, 1$, we are thus able to evaluate x_n and y_n for every day back to the first when—

marginal disutility of $(x_1 + y_1)$ labour

$=$ marginal utility of $(x_1 + o)$ income

$= C \times$ marginal utility of $(Cy_1 + x_2)$ income.

The labour of each kind on each day, the income of each day, and the number of days required to achieve the stationary state are precisely determined.

For Crusoe to discover this most economical behaviour when confronted with this simplest form of the problem would be a remarkable feat of skill, requiring a different kind of mental adjustment from that which would be involved if income were not homogeneous but required a daily balancing of different forms of labour expenditure on different kinds of products. But the fact that this problem is difficult does not prevent us from assuming that he will tend to behave according to this formula rather than in any other way—that, in other words, of all the possible

total amounts and distribution of that total amount of labour on any particular day, that which is the most economical (in the precise sense indicated) is the most probable. It must, of course, be remembered that if Crusoe does not adopt the most economical behaviour on the first day, the most economical behaviour on the second and all subsequent days becomes different from what it would have been, though, whatever the modification of the course of development resulting from such deviations, Crusoe will still arrive at the same goal, the stationary state, and this stationary state will be the same, by whatever route it may be reached.

Throughout development it will be noticed that the rate of equivalence or interchangeability of future for present income is C : 1. Future income is, therefore, discounted at the rate 100 (C — 1)% per day. This discount—calculated from the rate of exchange of future for present income—we will call "*the rate of interest, expressed as a percentage*". It will, however, be found more convenient to express the rate of interest not as the percentage reduction in the value of income on account of its futurity,[1] but as a multiplier giving the amount by which income at one time must be multiplied if it accrues at a later time, in order to be interchangeable with the earlier income.[2] A rate of interest of 0% is, therefore, called unity, and a rate of interest of 100 (C — 1)% is called C. In our example, the rate of interest stands at C [or 100(C — 1)%] throughout development, since a unit of income on any day is always worth C units of the next day's income. When the stationary

[1] Which means—in the absence of the psychological bias discussed in Chapter II under the title of "time-discount"—"on account of the greater amount of income in the future."

[2] For the meaning of "income" the reader is referred to the footnote on p. 3, and to the fuller definitions in Chapter III. The more customary contrasts, found in elementary textbooks, of capital as consisting of a lasting stock of wealth and income as a continuing flow from capital and labour are in these preliminary chapters provisionally ignored.

state is reached, the rate of interest drops to unity (or 0%), for a unit of income on one day then becomes worth a unit of income on the next day.

It might seem at first glance that such an equilibrium through time is not a probability for a community of individuals (faced with the same alternatives and inspired by the same motives as our simplified Crusoe) who are free to exchange income for labour and more mature goods for less mature, but enjoy no advantages from co-operation in labour (all the labour being still assumed to produce a homogeneous "cake" and not diverse and separately exchangeable constituents of real income). In the particular case of all the members of such a community having similar utility schedules for income and labour, each member will, of course, behave throughout in the same way as Crusoe, and all will arrive at the stationary state simultaneously. But, if there are differences in their utility and disutility schedules, some would reach the stationary state earlier than others. This clearly cannot happen, for those who would be in equilibrium if they were isolated would be prepared to sell income (produce of previous labour) for capital (rights over to-morrow's produce from to-day's labour) at any price under C income for 1 capital, while those who are still producing by both methods are prepared to buy income for capital at any price over 1 income for 1 capital. In other words, so long as the demand of those who have abandoned the use of direct labour is insufficient to entice the whole of labour to indirect production, the price of capital remains at 1 income for 1 capital, i.e. a rate of interest of C per day, but as soon as the last unit of labour is diverted from direct production, the price rises until it reaches C income for 1 capital, i.e. the rate of interest falls until it reaches unity (0%).

That this is just as determinate an equilibrium through time as in the case of Crusoe is clear enough, but there is

an important difference which may be indicated by saying that it is less probable.

In the case of Crusoe our equations show that there is a reference to the whole future at each moment of choice; and at each moment of choice—on each day when Crusoe decides on the apportionment of his labour—the equilibrium choice is the most probable choice. The probability of the whole equilibrium course of development is, therefore, low in proportion to the number of choices, owing to the absence of the equilibrating tendency through time already referred to in the case of static equilibrium.

In the case of a community such as we have considered above, the probability of the equilibrium course of development is of the same order as for Crusoe, only if we assume as much knowledge of the nature and allocation of the utility-schedules of other members of the community as Crusoe has of his own schedules. This is because an individual's arrangements for the most economical distribution through time of his labour and income require that he receive no unexpected bounty either from the failure of the rate of interest to fall or through its falling earlier than he would have expected.

But owing to the unexpected occurrence of these bounties the members of the community, however perfectly they would have made provision for themselves through time on the basis of the knowledge required if they had been Crusoes, will repeatedly find as development proceeds that it would have been more to their interests if they had behaved otherwise.

Actual economic development approaches more closely the pseudo-equilibrium that would be achieved if everyone made provision for the future on the same kind of basis as we have assumed for Crusoe (estimates of the future rate of interest entering into no one's calculations), and for some purposes it is convenient to regard the economic

development which would take place on this assumption as the true equilibrium through time, rather than that theoretical development which would enable us to say that the behaviour of the community as a whole through time was perfectly economical. Furthermore, in a world of slowly moving rate of interest the difference between the two kinds of equilibria is not a matter of very great importance, though under a highly skilled planned economy the distinction might be of greater significance.

We have seen that a true equilibrium through time is attained by Crusoe with difficulty even under the simple conditions postulated. The difficulty is obviously increased if we increase the alternatives open to Crusoe, though not to so great an extent as might be imagined, as will be shown in a later chapter. But if Crusoe's psychological future is considered more realistically, his difficulties of estimation are, of course, much increased. He knows that he is not immortal and that his attitude to work and income changes. This introduces no difficulty of principle, if his knowledge of these future facts is perfect. If Crusoe knows the date of his death, the stationary state will give place at a determinate interval from death to a process of decline of capital, and in so far as his attitude to work and income changes, the progression of income and labour will not show the evenness of increase and decline which would obtain if this attitude were invariable. But there is one irrationality which may afflict Crusoe and simplify his problem—he may " discount " the future. As a good deal of confusion surrounds the question of the significance of time-discount as a psychological bias in the theory of interest, a chapter is required for its elucidation.

Chapter II

PSYCHOLOGICAL DISCOUNT

When it is stated as a psychological fact that we discount the future, the simplest interpretation of this, in the case of economic affairs, is that the present marginal utility of a given future income is less than the future marginal utility of that income and that the present marginal disutility of any given quantity of future labour is less than the future marginal disutility. We can see what this means by taking a particular case. If I have before me a future economic state that is certain of attainment, and my disutility schedule of labour and my utility schedule of income are certain to be the same in the future as in the present, and if I am applying a given quantity of labour in the present to provide an immediate income and look forward to behaving in the future in the same way as in the present, then, given the reality of psychological discount, I should be willing to accept a transference of some future income to the present and some present labour to the future. Further, the degree of discount on this assumption is given by the ratio of exchange of a marginal amount of future income for a marginal amount of present income at which I just prefer not to make any exchange (this point being indicated by a point on an indifference curve). If this price is K (e.g. $\frac{21}{20}$) units of future income to 1 of present income, then the present marginal utility of future income is $\frac{1}{K}$ times the future marginal utility of future income. $100(K-1)\%$ is 'what is ordinarily understood by the rate of time-discount, expressed as a percentage, but

we propose instead to call K the rate of time-discount, a mode of expression that we shall usually find more convenient.

The more usual way of expressing a rate of discount is in terms of non-marginal amounts of future and present incomes that are assumed to be interchangeable as equivalents—a mode of treatment which could be an accurate statement of a real economic situation only if the elasticities of income utility and labour disutility remained the same throughout the whole of both schedules (so that if 100 were being exchanged for 105, 1,000 would be exchanged for 1,050).

Moreover, even if we did discount the future (in this world from which uncertainties are absent) we should rarely succeed in making the precise exchange that this analysis would dictate, owing to the changes in income that must be coming about in any world (either a developing world of perfect certainties or any other conceivable world) so that the popular method of expressing the assumed psychological discount becomes inapplicable or ridiculous.

If my income to-morrow is twice that of to-day, a 5% discount per day obviously does not mean that I will exchange only at the rate of 105 of future income per 100 of present income; it means that I will exchange, maybe, at the rate of 110 of future income for present income. Similarly, if my future income is only 50 and it is 100 to-day, a 5% discount is compatible with my buying future income at the rate of 95, say, of future income for 100 of present income. Even, in the case of a stationary state, with future psychological discount of, say, 5% this does not mean that, in spite of the fact that the income of every day is constant, I should part with 105 of future income for 100 of present income; it means merely that I will make one minute exchange at this price, or, in other words, that I am just unwilling to make any exchange at this price.

Only in the stationary state is it possible to express future discount as a ratio of future income to present income, and only in the sense that there is indifference to a *marginal* exchange of both incomes in that ratio of 105 : 100.

If, by a rate of discount K, we mean that the present marginal utility of future income is $\frac{1}{K}$ times the future marginal utility of future income, it is easy to see how we should discount future situations which are not similar to present situations. If, for instance, we have an income of 200 to-morrow and 100 to-day and our discount is 5% per day, then the present marginal utility of to-morrow's income is $\frac{100}{105}$ × marginal utility of 200 income. If x is the ratio of to-morrow's income to to-day's at which it is just not worth while exchanging, then clearly

the marginal utility of 100 income

$= x.\frac{100}{105}$ marginal utility of 200 income; which evaluates x.

If the marginal utility of 200 present income were, for example, $\frac{1}{3}$ of the marginal utility of 100 present income, then—

$$1 = x.\frac{100}{105} \cdot \frac{1}{3}$$

$$x = \frac{105 \times 3}{100}$$

The value of future income in terms of present is 100 : 315, instead of 100 : 300, which latter would have been the value-ratio in the absence of psychological discount.

It should now be clear how equilibrium through time would be affected by the existence of such discount. Instead of equating the marginal disutility of present labour with the utility of the marginal product in the future we must equate it with $\frac{1}{K}$ (where K is the rate of discount) multiplied by the utility of the marginal product. The course of

development is slowed down and a stationary state with less income and capital is achieved. If K is the discount, then when the stationary state has been achieved by Crusoe, in the nomenclature of the last chapter

$$\text{the marginal disutility of } y_s \text{ labour}$$
$$= \frac{1}{K} \times C \times \text{marginal utility of } Cy_s \text{ income}$$

and the rate of interest falls to K instead of to unity. It is necessary in this particular example, of course, that the discount be less than the productivity factor, C.

In the case of a community, the problem is, of course, more complicated, unless all the members of the community have the same discount-rate. If there are several discounts, the equilibrium course of development is modified in a way that depends not merely upon the average discount but on the way individual discounts are associated with individual utility-schedules. We do, however, know that the stationary state will have a smaller capital and income than would be the case in the absence of discount, and that the rate of interest will fall to a value that lies between the highest individual rate of discount in the community and unity.

It is not proposed to pursue further the mechanics of development when psychological discount is present, but instead to attempt to show that, in an exchange community, economically effective discounting of the future does not occur, and that it is only necessary to consider development on the assumption of a rational attitude towards time, involving no such discount, in which, therefore, the course of development apart from new inventions involves a falling rate of interest, disappearing (i.e. becoming unity, or o%) when the stationary state is reached.

It is not difficult to show that in so far as a person is rational he will not discount the future apart from allowance

for uncertainty. Let us assume he is faced with a future which is certain, over which he expects to have just the same attitude to income over the whole period, and that he cannot add to his income by labour. It is clear that he will spread this income evenly over the future. This is a corollary of rationality which no one will dispute. But we cannot deduce from this, as Schumpeter [1] appears to do, that discounting of the future does not occur, and that therefore the rate of interest in a stationary state is zero, unless we can show that this kind of rationality prevails. Static equilibrium theory does not assume that every one is rational, but only that there is sufficient rational bias for mistakes to be rectified through time, and for any mistakes that do occur to be equally distributed about what we might call the rational mean. Even if the rational members of a community, when faced with a clear situation such as we have suggested, make no discount, those that are not rational will be biased mainly in one direction, that of positively discounting the future, and only a fraction will be biased in the direction of negative discount; and the mistakes of the rational will, also, tend to have the former bias. It may even be suggested that our example is not as simple as it appears at first sight, for a really rational person would find some unevenness in the future distribution of income more satisfying than an even distribution, however similar his attitude to income remains throughout the period, unless we go so far as to wipe out both the memories of past satisfactions and the expectations of future satisfactions. If an income is so small as to give a mere dull existence, it might be more rational to arrange for one glorious week of abandoned revelry, at the expense of a trifling lowering of the income of all other weeks. But even if this be so, there seems no reason to suppose that there would be any bias in favour of discounting the future

[1] Schumpeter, *Theory of Economic Development.*

rather than the present, so that we may neglect this consideration. The practical difficulty is rather that of postulating a situation in which a pure psychological discount can be conceived.

We may, therefore, assume that in any real community there will be persons who discount the future, in spite of the irrationality of this procedure. But if we look into this more closely it is, I think, apparent that such discount applies to any considerable extent to the remote future only. The person who discounts next year at 1,000% per annum may discount to-morrow not at all, and there are very few indeed who would regard any part of a day as less significant than any other part. In other words, the tendency is to discount the near future, if at all, at a much lower rate than the remote future, after all the necessary allowance has been made for the greater risk that in practice is associated with the future. It must, of course, be remembered that some apparent discounting of the future is not pure psychological discounting. Even though I am sufficiently rational not to discount either to-morrow or the next day, and I am certain that the day-after-to-morrow I shall be alive to enjoy the income of that day, it may be rational for me to postpone income to to-morrow, while postponing none to the day after—for, if I am in a particular state of mind to-day, I may assume that I know that I shall be in an appropriate state of mind to-morrow, but less certainly[1] the day after. This particular kind of risk is neutralized in an exchange community, but must be an important consideration for Crusoe, whose risk-discount on grounds of the above kind, as well as his

[1] This consideration, in the case of certain types, may lead to much negative discounting. I may be now so vigorous and high-spirited that the forgoing of present economic enjoyments may seem almost a negligible loss, but I am always doubtful whether at a future date I may not need to spend heavily to make life tolerable. This seems a fairly rational attitude towards the prospect of old age.

apparent psychological discounting owing to the existence of this and similar kinds of risk, will completely obscure his pure discounting.

Now, if different sections of the future are discounted at various rates, it is possible for Crusoe to give effect to these rates, but he must constantly become aware of having made mistakes. For example, if he discounts to-morrow at only 2% per day but discounts the day after at, say, 5% per day, and he has available only one indirect method of production whereby his labour to-day matures into 8% more income in two days, then, assuming constancy in his attitude to work and income and assuming, of course, no risk, he will, even so, never apply any of his labour indirectly. But always, when to-morrow comes, he realizes that he should have applied some of his labour yesterday to the production of capital to mature to-morrow. He discovers a kind of inconsistency in his behaviour, which he would not find if he discounted the day-after-to-morrow at 2% per day, or to-morrow at 5% per day. He finds an inconsistency which does not appear if he discounts evenly or not at all. (I prefer not to say that on each day he wishes he had behaved differently on the previous day, for this is the case, even if he discounts at 2% only, and in a sense even if he does not discount or discounts negatively, since, apart from memory, the past is always done with, and we must always regret that we have not in the past sacrificed ourselves more completely to the present.) Nevertheless, even though Crusoe constantly discovers the inconsistency of his behaviour, that is no guarantee that he moves to a uniform discount of the future; though it must, presumably, tend in that direction. If, however, we add one more member to our community, the situation is changed, for on any day each is prepared to buy some day-old capital for anything less than 2% less income than it matures into and each is prepared to sell some day-old

capital for anything over 2% less income than the labour devoted to capital could, if not so devoted, produce directly in income. If both members know that the other has a similar utility schedule to his own, then either may devote some labour to producing 2-day capital in the expectation of selling it after one day on the favourable terms indicated above (though if they happened to move exactly in step no exchange would need to take place). We here reach the curious conclusion that the effective rate of discount for Crusoe is reduced to the minimum rate at which he discounts any future period, provided he is confronted with the possibility of exchange with another similarly constituted Crusoe. What happens might even be described as if Crusoe could be imagined as split into a chain of Crusoes existing on successive days, each exchanging with the proximate member, the effective discount being reduced to the rate at which he discounts the nearest part of the future. And if time is infinitely divisible the nearest portion of the future becomes indistinguishable from the present.[1]

Whether or not we accept this conclusion for Crusoe, it follows that in a community each person must behave as if he discounted the future at his own minimum rate, with the result that the question of whether the future is as a matter of fact discounted in any sense that has *economic* consequences for the whole community, is reduced to the question whether that part of the future that merges into the present is, as a matter of fact, discounted. To ascertain the answer to this purely empirical question is no easy matter, but in the absence of evidence to the contrary, we are justified in assuming that there is no such discount. The main reason why it has been assumed that effective discounting of the future does occur lies in the undoubted

[1] For all of us, in all circumstances, the "present" might almost be defined as that portion of the future over which our rate of discount is zero

fact that the remote future unquestionably is discounted by many people, but, as we now see, the existence of this fact has no relevance to economic problems, except when we are dealing with an isolated Crusoe.

Although in the theory to be developed in the following pages it is assumed that effective discounting of the future is absent, there is, as we have already seen, no consequence of importance that rests upon this assumption.[1] Effective discounting merely slows down the rate of development, and therefore slows down the rate of fall of the rate of interest, and leads to a stationary state with a rate of interest equal to this effective discount, instead of a continuance of the fall in the rate of interest to zero %, or towards zero % as a limit, according as there exists or does not exist any limit to the increases of productivity that can be achieved by lengthening further the processes of production.

[1] None the less, the formulae that are later worked out in this book are given in alternative forms to meet the views of any who find the above argument inconclusive.

Chapter III

SIMPLE CAPITAL

Retaining our assumptions of homogeneous labour and homogeneous income, and the assumption that capital is of a simple kind, maturing into income without further labour after the initial application through the mere lapse of time, it is possible for us to exhibit precisely the way in which Crusoe, or an exchange community without division of labour, will develop, however various are the periods of production of different kinds of capital, provided that these methods are fully known, and that present and future disutility and utility schedules (also fully known) are responded to rationally. As this can be conveniently and rigidly demonstrated only by means of an algebraic method, the argument is relegated to an appendix to this chapter. The main conclusions are presented here.

Let us first briefly review the process of development, on the assumption that longer methods of production are increasingly productive at a diminishing rate. Crusoe will, first, develop to what may be described as a momentarily stationary state, in which the shortest method using capital is adopted, and direct labour has ceased. But as soon as direct labour ceases, labour begins to be devoted to the next longer method, so that instead of a stationary state we have further development which carries him forward into a second "momentarily stationary" state in which production is entirely carried out by this more productive but more roundabout method. At each step, abandonment of the shorter capitalistic method is the signal for the adoption of a still lengthier method, and development

continues until longer more productive methods cease to be available, or until Crusoe's time-discount [1] calls a halt.

It might seem, at first sight, that even with a diminishing increase of productivity from the use of longer methods of production, Crusoe would adopt simultaneously several methods of production, allowing the simultaneous existence of pieces of capital of different periods maturing into pieces of income over a wider future, since in the absence of time-discount every day is as important as every other day. This, however, is not so for two reasons. In the first place we can only produce for the future; we cannot produce in the future for the present. Shorter methods are, therefore, at a premium, since we cannot make up in the future for the absence of income now by retrospective production; while the more distant the future the greater are the number of ways in which we can provide income for that future by anticipatory production. Owing to this uni-directional nature of time, the principles which govern the distribution of resources through time are different from those which govern the distribution of resources through space. In the second place, the repetition of a shorter method of production will necessarily give a larger income at a given future than a longer method that is equal in length to the sum of repetitions by the shorter method, so long as any still shorter method has not been completely abandoned, if we continue to assume that longer methods are increasingly productive at a diminishing rate. This point may be illustrated as follows. Let us picture a Crusoe planting trees, of which an infinite free stock is available, some of these yielding their complete crop in one day, some twice the fruit in 10 days, and some three times the fruit in 20 days. So long as Crusoe is still finding it necessary to plant any one-day trees, it cannot pay him to plant any

[1] The phrase "time-discount" is used as an alternative for the "pure psychological discount" discussed in the previous chapter.

other trees than 10-day trees; for when the fruit of such a tree matures, the labour no longer required for maintaining his previous income by means of one-day trees is available for planting two 10-day trees in place of each one-day tree previously required. If he had planted a 20-day tree in place of one of the 10-day trees, then on the tenth day there would have been no fruit, and labour would not have been released for planting the doubled number of 10-day trees. At the end of the twentieth day, instead of four times the fruit of a one-day tree, Crusoe would have had only three times the fruit of a one-day tree. Thus the planting of 20-day trees must wait until it is no longer necessary for Crusoe to engage in the planting of one-day trees. Obviously, this principle continues to work, preventing the planting of 30-day trees, until the planting of 10-day trees has been abandoned. Only two methods of production can be in simultaneous operation, and one method must be progressively displacing the other method, and the rate of interest, which turns out to be a ratio of productivities, expresses this fact, and moves downwards as the differences in productivity of each successive pair of competing methods diminishes, after allowance has been made for the difference in their periods of production. It must, however, be remembered that a diminishing increase of productivity with the lengthening of the period of production cannot be taken as a universal rule. The admission of exceptions to the rule introduces no special difficulties. The necessary complications of the theory required for the treatment of such exceptions are dealt with in the appendix to this chapter.

Throughout development, then, Crusoe is apportioning his labour on each day between two, and only two, methods of production, and on each successive day he is increasing the amount of labour that he devotes to the longer method and decreasing the amount that he devotes to the shorter.

Since this apportionment of labour is a deliberate choice, he is making a valuation of successive future incomes in terms of one another. If the product of a unit of labour by the shorter method is C_P, and the product of a unit of labour by the longer indirect method is C_P', when P and P' are the periods of production, he is in a position of indifference as between C_P income P days hence, and C_P' income P' days hence. The valuation of the income of one day in terms of the income of another day is what we have called " the rate of interest " (see p. 7) over the period separating these days. The rate of interest, in the above example, is therefore $\frac{C_P'}{C_P}$ over the period $(P' - P)$, P days hence, or expressed as a mean rate per day, the $(P' - P)$th root of $\frac{C_P'}{C_P}$,

$$\text{i.e. } \sqrt[(P'-P)]{\frac{C_P'}{C_P}}, \text{ or } \left(\frac{C_P'}{C_P}\right)^{\frac{1}{P'-P}}$$

The rate of interest thus becomes the equivalent of the rate of increase of productivity, provided that this latter phrase is interpreted in conformity with the above analysis.

As development proceeds, rates of equivalence (our " rates of interest ") are, therefore, being established between future incomes attaching to future moments which become more and more remote from the moments at which the decisions to apportion labour between alternative methods are being made. From the rates of interest thus established we can calculate both the values of the various kinds of capital in existence on any day and the value of labour on any day in terms of the income of any day, since this is only another way of looking at the incomes of different days ; for a given piece of capital on any particular day may be looked at as a given amount of income accruing on some later day, and any given amount of labour on any particular day is equal to an assignable amount of income on some later day.

If, therefore, Crusoe acts on every day so as to equate the marginal disutility of his labour with the utility of the marginal product, the quantities and values of labour, capital, and income are determined for every day throughout a determinate development, while the rate of interest from day to day is also determined, since it both expresses and is expressed by these valuations.

At this point it will be as well to formulate and define with more precision the fundamental concepts that our treatment requires. These definitions will have to be extended, subsequently, to cover the real situations of a more complex world in which capital is not simple, and income is not homogeneous.

Labour.—Let us take a unit of human activity (this term being available to cover what is usually called leisure, a word that rarely connotes simple non-activity) to be that amount of activity which, applied in some given manner by a given person, produces a given physical result. Then any substituted activity of the same individual, towards which such an individual is indifferent, is equally a unit of activity.[1] Also the activity expended by any other individual that produces the same result, however different may be its disutility, when we take into account the nature of this individual or his circumstances (e.g. the disutility will obviously be different if the work were performed under strain at the end of a long day's work and required, it may be, 1½ hours' work, from what it would be if it took up a single hour at the beginning of the day), is still to be described as one unit of activity.

Labour may now be defined as a unit of "activity" if it is applied to production, in whatever way it may be

[1] This is a further extension of the use of the conception of "indifference" for defining economic quantities, put forward by Hicks and Allen, *Economica*, 1934.

convenient to draw the line between what is and what is not "production".

Two important concepts result from this definition, the concept of a quantity of labour, and the concept of a flow of labour, or the rate at which human activities are diverted into production. This latter concept needs to be utilized in our equations of development: whereas when we are speaking of capital we are necessarily dealing with a stock existing at a moment and never with a flow.

Capital.—A unit of capital we define as any visible product of a unit of labour. Since a piece of capital undergoes alteration with the lapse of time, equal quantities of capital may have different physical constitutions even though destined to mature into similar products at different times, and may, consequently, have different values. In current theory there appears to be a continual shift between quantitative definitions of capital in terms of value and in terms of physical constitution or embodiment of labour. A definition in terms of value seems to lead to circular reasoning and cannot therefore be used as a means of applying the marginal productivity theory to the fundamental problems of distribution.

Two important concepts result from this definition: the concept of a quantity of capital, or embodied labour units, and the concept of a rate of change of the number of such embodied units, or the rate of increase of capital over a period of time.

Income.—A unit of income we define as a given quantity of some given capital at the moment of its disappearance (consumption).[1] A convenient unit is the product of a unit of labour (as previously defined) applied directly to production, i.e. to the production of capital which is consumed on the

[1] This is not intended to exclude from income those direct services in the rendering of which there happens to be not even a momentary emergence of visible capital. Direct services constitute a "limiting case" in the mathematical sense of that expression.

same day. It is convenient to take a day as an indivisible unit of time, and instead of regarding all production as involving the production of capital to speak of the production of capital which is consumed on the same day as the production of income by direct labour, though theoretical nicety suggests that we should regard direct labour rather as the class of methods of production whose periods are less than some given amount, such as a day.

It should be noted that we are not defining the quantity of income in terms of labour, for we are assuming income to be homogeneous, and the amount of any income can, therefore, be stated in terms of any unit we please. It merely happens to be convenient to make the unit of income the product of a unit of direct labour.

Given this quantitative conception of income, it is the concept of a flow of income, or rate of disappearance of capital, which is significant for the theory of development.

Earnings.—This term it will be convenient to use to cover what most writers define as income. It is the sum of what is here called income and any increment of income-value of capital that accrues within any period of which mention is made. In the absence of any distortion of capital values resulting from irregularities of development, earnings will be equal to the sum of income and saving (the latter term to be defined shortly), so that if income is greater than earnings, the difference is equal to the amount of dis-saving. The earnings of a community are, therefore, the national dividend valued in terms of units of income.

Rate of Interest.—This we define as the rate of change of the valuation of current income in terms of future income as income changes in the course of development. If we take a day as an indivisible unit of time, the rate of interest per day on any day is the valuation of that day's income in terms of the next day's income, or the ratio of additions to to-morrow's income to additions to to-day's income,

at which we are indifferent as between marginal additions to to-day's income and to to-morrow's.

Since the only way of valuing and exchanging the incomes of different days is by valuing and exchanging different amounts of capital maturing into different amounts of income on different days, the rate of interest from day to day over any given period may be regarded as an elliptic expression for the values of the various kinds of capital in existence at any time within this period in terms of the income of any particular day.

Investment.—The term investment requires careful definition if we are to avoid the mass of ambiguities in which many writers become involved. The most convenient use of the term would appear to be that which makes the incrementation of capital a function of investment, so that in a stationary state it would be zero. This use of the term also enables us to use the term " saving " in such a way that saving is a consequence of investment and would be zero in a stationary state. This allows of an economy in terminology, that renders it unnecessary to use the clumsy expressions " increment of saving " and " increment of investment " for those occurrences which most writers refer to as " saving " and " investment ", even though the use of these phrases would at times be a safeguard against the introduction of those fallacies, that necessarily accompany the common practice of using these terms in more than one sense without specific warning.

It is commonly overlooked that the terms " saving " and " investment " are two-dimensional. Saving is admittedly the non-receipt of income (non-destruction of wealth) over a period of time; and it seems convenient to treat the term investment on parallel lines and use it to refer primarily [1] to the devotion of labour (if we neglect other resources) to lengthened methods of production.

[1] A necessary broadening of the use of the term is indicated later.

If x labour engaged on a method of production that takes P days before the capital matures into $x.C_P$ income are transferred to a method that takes P′ days and produces $x.C_P'$ income, we shall speak of an investment of $x(P' - P)$ units, and a saving of $x.C_P(P' - P)$ units, and an incrementation of capital of $x(P' - P)$ units. As long as these units of labour continue to be applied in this way, there is, of course, no further saving and no further incrementation of capital.[1] It must be remembered that the saving occurs over a definite period in the future, and the incrementation of capital takes place over this same period, commencing P days hence and reaching completion P′ days hence. The investment, on the other hand, may be said to "take place" on the day labour is changed over from one method to another, provided we are careful to interpret this statement in the way indicated.

Not only may the period of production for labour already employed be altered, but the amount of labour employed may be changed. If y additional units of previously non-existent labour (i.e. the daily flow of labour is increased by y units for this purpose) are employed on a method of period P, then there is an investment of yP units and an incrementation of capital of yP units which is complete in P days, and the income saved is y units for P days, or a total of yP units (since we have defined a unit of income as the product of a unit of direct labour). Similarly, if z units of labour previously applied to a method of period P now cease to be so utilized, there is a disinvestment of zP units, a decrementation of capital of zP units, and a dis-saving of $z.C_P$ units, i.e. income received but not replaced by any income in the future.

It is, I think, an unduly simplified picture of production

[1] As will be made clear later, if they revert at any time to the shorter method, this reversion will be described as disinvestment involving dis-saving.

that has led to confusion on this point. Labour is pictured as being applied in two ways : on the one hand, as co-operating with capital instruments in pouring out consumption-goods (i.e. income) ; on the other hand, as producing further capital instruments ; and this latter activity is called investment. If we divert labour from the former process to the latter, then the income not produced can certainly be said to be saved ; but only in a loose sense can the saving be said to be equal to the simultaneous investment, or the investment and saving be said to continue *pari passu* if such new capital instruments continue to be produced. Moreover, if, instead of a diversion of labour, there is a net increase of labour which is applied to the production of instruments, then while it is agreed that the saving corresponding to this investment is the income that could have been produced by this labour either by non-capitalistic methods or by the use of instruments previously idle, the mode of analysis we are criticizing involves the conclusion that different amounts of saving will accompany what are, in fact, identical amounts of investment. It is true, of course, that such diversions of labour do frequently occur in a world of perpetual disequilibrium (the only world which the " realistic " economist consents to envisage) and their consideration has naturally been allowed to overshadow the study of the continuous normal replacement of one method of production by another ; with the result that what is fundamental to the entire process of development is completely left out of account. In defence of this rejected analysis it may no doubt be suggested that it is only put forward as a means of showing that the value of new investment is necessarily equal to the amount of saving expressed as a value. This, however, would amount to nothing more than stating the consequences of given definitions ; since, if new investment of a given value takes place within any given period, then earnings are increased by that amount without

any increase of consumption (i.e. income in my sense), and therefore saving equal to the value of new investment has necessarily taken place.

A frequent use of the term investment abandons the attempt to define it without reference to valuation, which means, in effect, to define investment as saving, as may be shown by the following considerations. Let us suppose that a quantity of labour is changed from a method of period P to a longer method of period P′. Then, for P days, income appears as before, and a new kind of capital takes the place of the old, though the value of this capital is equal [1] on each day to the value of the capital that would have been produced, if there had been a continuance of the old method (assuming that the old method is still being progressively abandoned). Therefore, for P days, the value of capital is not incremented and therefore, according to a value-definition of investment, there has been no investment. For the next (P′ − P) days, income that would have been received fails to mature, but the amount of capital increases, and the increment of value of capital in terms of income on each day is equal to the saving of income of each day, so that investment and saving are equal and take place over the period P to P′, although the significant act of investment ought surely to be regarded as commencing P days earlier. This shows that if the term investment is not to include a reference to the period of production it is a redundant term, since it means what is already covered by the term saving; for the structure of production can undergo a change without there being any accompanying indication of this change in the form either of the amount or value of capital or in the amount of income. The nature of capital may change over a period, and the only clue to

[1] This is so because labour is being simultaneously devoted to the production of both kinds of capital and therefore the marginal utility of each kind of capital is the same.

this change is given by the different time-labels that become attached to particular capitals over this period.

We now see that any change in the way in which labour is applied to production is the expression of acts of investment or disinvestment. An increase of indirect labour is an act of investment and a lengthening of the period of production is an act of investment. A decrease of indirect labour or a shortening of the period of production is an act of disinvestment. The changes that accompany development may thus be regarded as resulting from two kinds of investment activity and two kinds of disinvestment activity. It is important to realize that investment and disinvestment normally go hand in hand, for changes in the flow of activity (from changes in population, whether its quantity or its quality) will cause changes in the flow of labour, while simple development causes simultaneously both disinvestment, owing to the diminished conversion of the flow of activity into production (owing to the falling marginal utility of income as income increases and the consequent increase of leisure), and also investment, owing to the transfer of labour to lengthier methods of production.

If we compare the labour of one day with the labour of the next in a period of normal development, we find that some labour continues to be applied in the same way, i.e. x labour is applied on both days to the shorter method of production, and y labour is applied on both days to the longer method. But, also, z labour applied on the first day to the shorter method, is applied on the second day to the longer method. If P is the period of production of the shorter method and P′ is that of the longer, then there has been an investment of z units of labour for (P′ − P) days, with an effect on the quantity of capital commencing P days hence. We also find that w units of labour, applied on the first day to the shorter method, cease to be applied, so that there has been a disinvestment of w units of labour

for P days, with an effect on the quantity of capital commencing P days hence. An act of investment is thus not completely characterized unless we specify both the amount of labour and the period of time and the moment, present or future, on which the period hinges.

This conception of investment may be clarified by introducing some further terms. On any given day, each unit of labour may be regarded as having a definite period of production, the time which elapses between the production of capital and its disappearance as income.[1] Let l be the number of units of any particular labour with a period of production p applied on a particular day, then we will call lp the "production-factor" of that labour on that day. If L be the total labour of different production-periods applied on the same day, and l is the amount of labour of any particular production-period p, so that $\Sigma l = L$, then we shall call Σlp the aggregate "net production-factor" of the total labour of that day. While in a stationary state the quantity of capital is necessarily equal to the net production-factor of each and every day, in a developing state an increase in any particular production-factor leads later to an equal increase in the quantity of the corresponding capital, and an increase in the aggregate net production-factor leads to an equal increase in the aggregate quantity of capital, expressed as an average over the appropriate future period of time. The necessity for stating it as an average results from the fact that the "production-factor" has two dimensions, time and labour.[2] The "net production-factor" may remain unchanged, even though the constituent l's and p's vary. For example, with the net production-factor Σlp remaining unchanged, the period of production

[1] The difficulties in the way of this conception when capital is not simple are dealt with in the following chapter.

[2] What is really the same point is treated in a geometrical way by Professor Hayek in an article, "Relationship between Investment and Output," *Econ. Journal*, 1934.

of some labour may decrease while the period of production of other labour may increase, and if this be the case the quantity of capital will (for example) after a time diminish, then increase to a figure greater than Σlp, and only after a still greater interval return to the figure Σlp. The average quantity of capital over this whole period of change will, however, be exactly Σlp.[1]

These definitions make the net investment of any day the same thing as the change of the net production-factor, so that the average incrementation of capital over a period of time is a function of the net investment activities of earlier days. A given amount of investment (i.e. increase in the production-factor) is thus compatible with any change from one day to another in the amount of capital and any change from one day to another in the amount of income, so long as there is a period over which there is an average incrementation of capital equal to the amount of investment, and an average alteration in the flow of income, such that the net saving over this period is a function of the amount of investment and the previous productivity of the transferred labour. If we analysed the net investment of a day into the sum of acts of investment and disinvestment of that day, i.e. into the sum of changes of the production-factors of that day, we would, of course, be able to deduce the subsequent changes in the quantities of both capital and income, attributable to the investment. Since, however, the changes from day to day of capital and income are the consequences of the investment of a number of days, the actual change of capital

[1] In our definition of quantity of capital we have avoided any reference to time. In order to characterize a piece of capital completely the concept of production-factor may conveniently be extended to cover the labour embodied in capital. The production-factor of a piece of capital at any given moment is defined as the sum of quantities of labour embodied in it multiplied by their periods. The production-factor of a piece of simple capital (which is quantitatively the same capital through time) therefore diminishes gradually as it passes to maturity.

and income on any one day is only to be explained by a very complex reference to past investing activities.

A further analysis of the act of investment is, therefore, required to bring out these relationships. Now the " production-factor " of a single unit of labour is simply the period of production (i.e. $1p = 1p$), so that a change of its production-factor is simply a change in its period of production. Let us call the change in the period of production the " period of investment " so that a change in the period of a single unit of labour from p to p′ is an investment of $1 \times (p' - p)$ with a period of investment of $(p' - p)$. Let us call the " rate of investment " the $\frac{\text{amount of investment,}}{\text{period of investment,}}$ (i.e. in the case of a single unit of labour $\frac{p' - p}{p' - p}$) then the rate of investment is given by the amount of labour, the period of production of which is lengthened. In other words, an investment $1(p' - p)$ where 1 is the number of units of labour is analysed into a " rate of investment " 1, and a period of investment $(p' - p)$. When an investment $1(p' - p)$ takes place, i.e. when the production factor changes from $1p$ to $1p'$, we shall speak of a rate of investment 1 occurring on every day for the period of investment $(p' - p)$. It will be shown that the rate of investment refers to a period beginning p days earlier than that on which the period of incrementation of capital begins, though both these periods are equal to $(p' - p)$.

The convenience of these definitions may be brought out by considering a concrete act of investment. Let us suppose that wine is being produced by a method that requires 5 days for the bottles to mature, and it is now found that better [1] wine can be produced by a change in technique

[1] If we kept pedantically to our assumption of the homogeneity of income, we should need to think of this as a larger quantity maturing in each bottle.

using the same amount of labour per bottle laid down, and 15 days for the bottles to mature. If l is the quantity of labour, engaged on this work, and it lays down one bottle per day, the production-factor is changed from 5 l to 15 l, and the amount of investment is (15–5)l, and the rate of investment is l for 10 days, the period of investment. Now, on each of the first 5 days, a bottle of 15-day wine is put to mature instead of a bottle of 5-day wine, so that there is no change in the number of bottles (the quantity of capital) and no change in the output of wine, since the same amount of wine is reaching maturity as if the production-factor had remained unchanged (i.e. as if there had been no investment). But on the fifth day, the last bottle of 5-day wine passes to maturity and is consumed, and we have a stock of 5 bottles of 15-day wine, 1, 2, 3, 4, and 5 days old respectively. On the 6th day, the number of bottles increases for the first time, becoming 6, so that capital is incremented by 1 unit, and there is no output of wine, and this process continues until the 15th day, by which time there are 15 bottles. After this the stock of capital remains constant at 15 bottles instead of 5, the income remains constant at the higher level of one enlarged bottle per day. From the 1st to the 10th day there has been a rate of investment of l; from the 6th to the 15th day there has been a rate of incrementation of capital of l, and from the 6th to the 15th day there has been a rate of saving of 1 bottle of poor wine. Let us call a mature bottle of poor wine (the product of l units of labour), m units of income, then an investment of 10 l has led to an incrementation of capital of 10 l and a saving of 10 m. And this investment of 10 l has led to a rate of investment of l for 10 days, a rate of incrementation of capital of l for 10 days, commencing 5 days later, and a rate of saving of m units of income for the 10 days during which capital is being incremented at the rate l. We may

note that the act of investment was accompanied by no saving, the output of wine being unaffected for 5 days. The rate of investment was unaccompanied by saving for the first 5 days—the change being only a change in the structure of production, labour continuing to be applied in the same way on each of the five days; incóme of wine continuing to appear in precisely the same way on each of these days, and the number of bottles remaining unchanged (with, however, the appropriate changes in all the time-labels each day). The rate of investment is accompanied by saving during the next 5 days, i.e. income ceases and the stock of bottles grows each day. The rate of investment comes to an end on the 10th day, but saving continues for another 5 days; and we do not continue to speak of a rate of investment, for we are now doing no more than what will maintain the intended new structure of production, which will be complete in 5 days, for the saving is the consequence of our not reverting to the 5-day method. On the 10th day we could still have prevented the last day's saving of this final period of adjustment, by reverting to the 5-day method. On the 11th day this becomes impossible, the saving henceforward being the consequence of the period of production of 5, abandoned in favour of a period of 15, being equal to the days remaining for the new structure of production to become established. It is "impossible", that is, without subsequent dis-saving beginning at the 15th day.

If it is suggested that the term investment ought to be used in such a way that when capital is in process of incrementation, investment is simultaneously taking place, then rate of investment merely becomes a synonym for rate of capital-incrementation and we are left without a term to bring out the relationship between capital-incrementation and the change in the period of production, which latter is responsible for the incrementation. If,

for example, in the above illustration, labour reverted on the 11th day to the production of 5-day wine, the output of wine up to the 15th day and the rate of incrementation of capital and the rate of saving would all be unchanged. But on the 10th day, the last day (according to our analysis) on which there is a rate of investment flowing from the original act of investment (or change of production-factor from 5 l to 15 l), a reversion to the 5-day method would have prevented the last intended capital and income of the 15th and subsequent days from being achieved.

One other alternative definition of investment, requiring no reference to value and yet not synonymous with capital-incrementation would be the following, namely, that investment occurs over the whole of the 15 days from the day on which the production-factor changes to the day on which the new structure of production is complete and capital is fully incremented. But this involves making the rate of investment of any day unequal to the incrementation of capital of that day or of any other day, which would involve an unnecessary awkwardness that is avoided by the use of the definitions here adopted.

It is not surprising, in view of the absence of attempts to frame definitions of investment on some such lines as those here adopted, that investment is so frequently defined by reference implicit or explicit to value. But any such reference is bound to make the term investment become a synonym for saving, as may readily be shown by reverting again to our wine-illustration. On each of the first 5 days there is no change either in the quantity or the value of capital, so that if investment is defined by reference either to the increment of value of capital or to the value of the increment of capital, there is necessarily no investment. On the next 10 days there is a rate of incrementation of capital, and an incrementation of the value of capital, which latter under normal development

will be equal to the rate of saving. Only if the act of investment, as the term is here used, turns out to be a mistake, or if, for some reason, there is a mistaken valuation of capital, would it be possible for investment, defined as the incrementation of value of capital, to be different from saving. This would be tantamount to saying that when we commit resources in a way which proves to be uneconomic, what would have been labelled as so much investment is not to be labelled investment, or (what would be even worse) if mistaken evaluations of capital are subsequently made the amount of investment from a given commitment of resources is thereby altered. If resources are diverted to the production of a railway, which turns out not to pay, it is an awkward terminology that requires us to discover this fact before we know how much investment, if any, has taken place.

A variation of this type of definition is to make investment refer neither to the simultaneous incrementation of capital nor to the incrementation of value of capital, but to the value of the increment of capital.[1] A reference to the above example of wine shows that a definition on these lines involves contradictions, unless we mean merely the increment of value; for only after the first 5 days is there in existence a quantity of capital consisting of identical components corresponding one by one to the capital of the previous day to which a quantity of capital is added, namely, 5 bottles of wine (1, 2, 3, 4, and 5 days old) exactly similar to 5 bottles on the previous day, to which we may say that a new bottle is added, legitimately described as a 6-day bottle (though it is actually a first-day bottle accompanied by a pushing forward of the time-labels of the whole series). On the preceding 5 days, one kind of capital is of necessity diminishing while the other kind is increasing, so that the increment of capital is necessarily

[1] Cf. Keynes, *Treatise on Money*, vol. i, ch. ix.

an increment of one kind and a decrement of the other kind, and the value of the increment minus the value of the decrement will be all that we can mean by the increment of value ; and this will normally be zero. We are, therefore, still unable to give to the term investment a definition that will allow investment to be something that occurs at the time when the change is made in the utilization of resources.

If any further justification for the terminology here adopted is required, attention may be drawn to the commonly realized fact that the mere act of saving does not cause capital to accumulate. To go without something is not to create wealth. If investment is a synonym for saving, then investment, equally with saving, is empty of reference to the use of resources. If, however, saving is regarded as the consequence of investment, investment must refer in some way to the change in the way resources are used. Investment must, therefore, be regarded as occurring at the moment the change is made in the use of resources, or it must be spread out over a period of time, commencing at the moment of change. If this is admitted, then we have investment as an act on a particular day when a change occurs, and, for convenience of analysis, a rate of investment over a period of investment commencing on the day the change takes place. It is, therefore, never an explanation of the incrementation of capital, either as a quantity of embodied labour-units or as a value, to refer to a simultaneous investment, however we define the latter term, and there is, I think, little doubt that the confusions that follow on the acceptance of this assumption of simultaneity are the result of a failure to appreciate that, given the quantity of labour, capital is increased only by a lengthening of the process of production.

The choosing of an appropriate definition of the term " investment " is bound up with the attempt to solve the

problem of where to locate those decisions upon which economic development depends. Neither a Crusoe, nor an exchange-community, can make any change in consumption, except by making a change in the amount of labour or in its utilization. Consumption and saving turn out to be simply the consequences of investment. Consumption and saving are what they are in consequence of decisions to invest, to dis-invest, or to refrain from investment.

This, however, is an over-statement, because the assumption that every unit of labour can be assigned its period of production at the first moment of application is only partly justifiable. For the economic system is not perfectly rigid in this respect. In the case particularly of fixed capital the intention held while it is under construction that it should be used and maintained in a certain way may not subsequently be fulfilled. The period of production of some of the labour may thus turn out to be shorter than was intended, and the quantity of investment may turn out to be less than would have been the case if the original intentions had been kept to. This possibility of a change of intentions, however, does not affect the rate of investment that flows from the original act of investment until the change shows itself in a change of behaviour. As soon as such changed behaviour manifests itself, a statement of the amount of investment attaching to the original act must be revised so as to be consistent with the changed rate of investment. An act of investment thus determines the future between limits set by the possible deviation of actual periods of production from what was intended at the moment of investment. From any one act, as intended, a rate of investment flows, and changed circumstances can alter this rate of investment only within certain limits given by the technical possibilities of revision of the intention. Thus, consumption and saving are completely determined by antecedent rates of investment, while the

rate of investment at any moment is only a matter of decision to the extent to which by revision of intentions we alter the period of production of past labour, and thus are led to revise the quantitative expression of past acts. This flexibility of the economic structure is found to depend mainly, as we shall see, on the nature of fixed capital,[1] to which labour may be applied for three purposes : utilization, maintenance on account of use-depreciation, and maintenance on account of time-depreciation. The extent to which the labour used for these three purposes departs from the original schedule of intentions gives the extent to which the estimate of the production-factor of the labour of construction and, therefore, the estimate of the quantity of past investment must be revised, so that the future rates of investment flowing from past acts of investment are changed.

In a world of simple capital we have hitherto assumed that flexibility is absent, every unit of labour having a defined unalterable period of production from the moment of application. The production-factor, at any moment, has been taken to be incapable of future revision ; and income, saving, and rates of investment therefore flow from acts of investment without any possibility of modification. In our account of a world intended to show the essential characteristics of capital in its simplest form, we might have taken one step away from (or, in some ways, nearer to) reality by assuming that all capital is capable of removal as income at any age, though capable of being allowed to remain to mature into larger income. For example, let all income be of the nature of slowly maturing wine and let better wine be regarded as the equivalent of more wine. And let the goodness of wine be a function of its age. Instead

[1] There are, of course, also disturbed conditions in which the period of production of working capital is subsequently altered by deliberately holding more or less than the normal quantities of stocks, including what is commonly called liquid capital.

of decisions to perform definite amounts of labour on each day and to divide this labour appropriately in laying down wines of different periods each of which must be consumed on its assigned day of maturity, so that income and saving are thereby determined, there will be decisions to change or not to change the quantity of labour and to consume a quantity of wine, which may be anything from zero up to the total stock accumulated. In such a world, decisions are made to consume so much and to save so much, and investment which in the rigid world has been treated solely as a determining cause controlling future consumption and future saving, becomes, in part, a consequence of these flexible decisions relating to consumption. In other words, the period of production of any unit of labour is not determined until the wine in which it is embodied is deliberately consumed. In this flexible world, although all economic decisions are decisions to work and to consume, there are different ways of consuming the same income, for we may consume many early bottles or few maturer bottles to obtain the same income, and the amount of future wine (in the sense in which better wine is a larger amount) is thereby affected. By not consuming all the bottles on any one day, the remaining bottles become one day older on the next day, so that the consumption of fewer of these older bottles on this day provides us with an unchanged income, and therefore, with no change in the amount of labour, the number of bottles is increased, i.e. capital is incremented. Obviously, the amount of capital, the rate of labour per day, the rate of income per day, and the rate of interest will all move in such a flexible world in precisely the same way as on the assumption previously adopted, that each bottle is earmarked for consumption on a particular day (so that labour must be allocated to producing wine of a particular period) longer-period wine being laid down as development proceeds. The only difference between what

would happen in our rigid world (the development of which is more fully worked out in the appendix to this chapter) and the flexible world just considered lies in the possibilities of adjustment if previous technical or psychological forecasts call for revision.

The real world is, as a matter of brute fact, nearer to our rigid world of simple capital, though, as already pointed out, some flexibility (though much less than is often taken for granted [1]) is given by the nature of fixed capital. Since most of the problems of adjustment in the real world flow from the rigidity of the capital structure, our theorizing is better done on the extreme assumption of complete rigidity, since it is not difficult to state the general lines on which modifications are required for dealing with any degree of flexibility which does exist.

Saving.—Since we are using the terms investment and saving in such a way that both are zero in a stationary state, any deviation from a uniform distribution of income through time is necessarily an expression of saving or dis-saving. Since investment is a change in the way in which labour is applied to production, and causes, therefore, a deviation from uniformity in the distribution of income in the future, saving is simply the consequence of investment. An act of investment leads to the replacement of income at one future moment by income at another future moment. Saving is, therefore, the involuntary sacrifice of earlier for later income, and dis-saving the involuntary sacrifice of later income for earlier income.

By our definition of a unit of investment this becomes the sum of such a group of acts of investment and disinvestment as gives rise to a unit increment of the stock of capital. If, therefore, x units of labour are changed from a method of period P to a method of

[1] e.g. by those whose views on saving have been previously criticized, pp. 28–30, 36–9.

period P + y, then there has been an investment of xy units. We can define a unit of saving on the same principle. If x units of income are saved (i.e. x units of income do not appear) for y units of time, then there has been a saving of xy units. With this definition of a unit of saving, the amount of saving which results from a unit of investment necessarily increases as longer methods of production having a diminishing rate of increase of productivity are adopted. (For investment is the lengthening of the period of production of a unit of labour and does not refer to the absolute productivity of the labour lengthened, whereas the consequent saving is the saving of the income from that labour and therefore refers to its original productivity.)

In one sense saving and investment are rightly regarded as equal, since they are two aspects of the same phenomenon ; but they are necessarily unequal quantitatively, except by accident in particular cases. Since we have chosen to define a unit of income as the product of a unit of direct labour, investment and saving, expressed in the units appropriate to each, are equal over the first period of development from direct to indirect labour ; but as soon as direct labour is entirely abandoned, the number of the units of saving exceeds the number of the units of the corresponding investment to a greater and greater extent, as the methods that are being abandoned are progressively more and more productive methods.

Unlike investment, saving may be said to occur simultaneously with the incrementation of capital, but the incrementation of capital is not proportional to the amount of saving, owing to the increasing productivity of the roundabout methods that accompany or constitute development. But, under normal development, the increment of income-value of capital will be precisely equal to the amount of saving, so that a unit of saving is the result of

a unit incrementation of the income-value of capital, while a unit incrementation of the quantity of capital is the result of a unit of investment. We cannot, however, use this as a definition, since a stock of capital may be "wrongly" valued as a result of mistakes and monetary influences; and saving, if we adopted the increment of value of capital as a definition, could change without any change in the time-distribution of income, and this would be incompatible with the conception of saving as an aspect of investment (since investment involves a postponement of income).

The usual definition of saving as the excess of earnings (the income of most writers) over consumption (income in my sense) has the defect that saving can change without any change in the saving of income (in my sense), if for any reason, such as banking activity, there is an "irrational" valuation of capital in terms of income.

We found it convenient to analyse an act of investment into a rate of investment for the period of investment, so that the amount of investment equals the rate of investment multiplied by the period of investment (see p. 34). We can adopt the same procedure for the act of saving, which may be conveniently analysed into a "rate of saving" for the "period of saving". Since the period of saving is necessarily equal to the period of investment (though commencing at a later date), the rate of saving corresponds to the rate of investment of an earlier moment, and is quantitatively related to it by the ratio between the productivity of the method abandoned and the productivity of direct labour. Under normal development, the rate of saving of any particular day will be equal to the excess of earnings over income; but an abnormal change of capital values without any change of consumption and production does not affect the rate of saving or of investment on the above definition, whereas the definition by reference to earnings is compatible with any change in the rate of saving,

and, therefore, is no help to the elucidation of the real occurrences underlying the accumulation of capital.

We have seen that saving implies preceding investment, but the quantity of saving is a function not only of the quantity of investment but of the productivity of the method of production which is being replaced. Furthermore, the rate of saving is a function of the rate of investment and of productivity.[1] The importance of this distinction between the amount of investment and the rate of investment and between the amount of saving and the rate of saving may once again be emphasized. Since an investment lp is two-dimensional, a given amount of investment may be made up of any values of l, the rate of investment, and of p, the period of investment, so long as "lp" is unchanged. The same quantity of investment may give rise to a lower rate of saving for a longer period or a higher rate of saving for a shorter period (though the absolute rate of saving depends on the previous productivity and the transferred "l").

Our use of the term saving[2] has the advantage that it is synonymous with waiting or abstinence, and the further advantage that although saving will necessarily, in equilibrium, be accompanied by a rate of interest, interest is not the price of saving in the sense of a supply-price equalling a demand-price. It is usual in traditional theory to define saving in any way that makes the rate of interest appear as its reward, and then to assume without further analysis that saving, defined in such a way, is equivalent to waiting or abstinence, so that interest may become the price of these latter. Those who approach the problem in this way appear to use the term saving to cover the mere maintenance of an existing capital (a process which on our use of the

[1] If C_P is the productivity of the method being abandoned then $C_P = \frac{\text{Saving}}{\text{Investment}} = \frac{\text{Rate of saving}}{\text{Rate of investment}}$.

[2] i.e. the transfer of income from one time to another time (see p. 43).

term involves no saving), so that a lengthening of this structure, with the accompanying postponement of income, involves what such writers might with greater consistency call an increase of saving. For it must be remembered that in the stationary state the amount of saving, in the one sense (i.e. the sense of what is required to maintain the capital structure), is at a maximum while in the other sense (i.e. the sense of postponement of income with a view to future increase of income) it has fallen to zero, since it is now a function of the amount of capital (which of course is at a maximum when the stationary state is achieved). In fact, saving in the one sense is a function of the round-aboutness of production, and is given by what I have called the net production-factor. If we proceed to identify saving in this sense with abstinence or waiting, we have the odd result that abstinence or waiting is at a maximum in the stationary state.

Let Crusoe abandon direct production for a simple capital method, the laying down of bottles of wine which take 15 days to mature. For 15 days he is obtaining no income, and is, therefore, abstaining or waiting; but on the 15th day income begins to appear and he can thence-forward proceed for ever performing the same labour each day and receiving each day an income, which is greater per unit of labour than when his labour was direct. On this view that we are disputing his abstinence and waiting are at a maximum after the new method has been fully established. In what, then (according to this view), does Crusoe's abstinence consist?

It consists during the transitional period of the immediate income he is sacrificing in favour of an income that is to appear after 15 days; but in the achieved stationary state it can only consist of the income that he might have obtained from using his labour directly. But if he used his labour directly, this would mean a smaller

total of income 15 days later owing to the reduction of capital that accompanies such a retrograde movement away from the existing stationary state. If Crusoe does not discount the future he cannot feel that he is receiving a reward for not regressing; but if he discounts the future he is able, by adopting a less productive stationary state in which his income is smaller, to argue that he obtains a reward for not regressing, and he obtains this reward by assigning to his labour a value which is less than it would have been if discount were absent by an amount greater than that part of his income that he treats as interest. But Crusoe will only make this distinction between interest and wages if he has been brought up on the traditional theory of distribution. He is much more likely to regard the whole of his income as the product of his labour and will be quite unconscious of any compulsion to treat part of his income as being paid (so to speak) by one part of himself to another part for the service of refraining from reverting to a less productive method of utilizing his labour. If, however, Crusoe finds himself in a community of individuals with a higher time-discount than his own, the situation is altered; for he finds that the value of other labour is less than his own, and this labour he buys with income at a price equal to its productivity by the shorter method, directing it to the lengthier method he himself is using. The analysis into wages and interest is now forced upon him. His own labour is no more productive than the labour of others now devoted to the longer method upon which he is himself engaged, and the surplus product he obtains both from his own labour and the labour of others appears as interest—the reward, namely, for not himself reverting to a shorter method as well as for persuading others to use the longer instead of continuing with the shorter method. If we make the time-discount of some members of the community sufficiently great and the discount of others

sufficiently low, the labour of the latter could be reduced to a negligible figure and their income raised appropriately, so that practically the whole of this raised income would appear as the reward for abstinence and retain this form indefinitely. The interest they receive may be thought of as the reward for not allowing the capital structure to collapse to a simpler form, a reward they would not obtain but for the "irrationality" of the others.

Similarly during development, even in the absence of effective time-discount, a rate of interest emerges as a reward not only for the "abstinence" connected with lengthening the processes of production but for refraining from shortening them. As Crusoe diverts more and more of his labour from a shorter method to a longer, the labour that is simply maintaining that part of the longer structure already built up, as well as the labour that is being switched over from the shorter method and in process of building up the longer structure, is frequently portrayed as being accompanied by "abstinence" merely because the labour could regress to a shorter method. Moreover, Crusoe is continuing to devote some of his labour to the shorter method though in ever-decreasing amounts. If, therefore, Crusoe values his labour in terms of the income that accrues from the shorter method, he finds that there is a surplus from the labour that is already receiving product from the longer method, and this surplus he therefore naturally regards as interest. If Crusoe, after the longer structure has been completed should find himself in a community which has not yet completed this lengthier structure, he would value his labour at an unchanged figure (its productivity by the shorter method), and regard the whole of his surplus income as interest and draw an additional income as interest as soon as he had adjusted himself to the situation; for he could then induce others to lengthen the period of production of their labour and draw interest as a payment for not letting the

new structure collapse. As the capital of a community increases and as the rate of incrementation increases, the extent to which interest becomes a payment, in this way, for the "abstinence" of not allowing a capital structure to collapse increases as compared with the extent to which it is a payment for the unquestionable abstinence involved in actual lengthening.

In analysing cases of this kind we have so far ignored the fact that as a general rule a structure already exists which has itself come into being by the progressive lengthening of previous structures. But, clearly, if we are to be consistent, any abstinence that is taking place should be described as the abstinence of not reverting, not merely to the last structure built up, but to the structure next in order of simplicity and backwards until we reach the situation of pure direct labour. This is true; but this "abstinence" (on the part of the capitalist) is clearly not rewarded since labour can obtain a price equal to its productivity under the least productive of the methods actually in use.

Those who treat "saving" as the correlative of interest (making the term applicable only where interest is received) are in effect refraining from defining the term, since they neglect to explain the difference between the second and the third of these three cases. This is perhaps the most usual mode of dealing with "saving" but it cannot be fitted into any definition of "saving" that makes it the equivalent of abstinence. Even this type of definition appears to be abandoned by Professor Pigou when he deals with a stationary state in which there is a rate of interest on account of time-discount; for he seems to imply that there is no saving in such a stationary state. It must then be allowed that if the term saving is used in such a way that interest is the price of saving, saving can occur in the stationary state and saving cannot be identified with waiting

or abstinence, either in the stationary state or during development; for saving now becomes not only the process of abstaining when we go without now for the sake of a greater product in the future, but also what is involved in not regressing to that simpler capital structure the maintenance of which cannot get such a reward. Thus, while all real abstinence is rewarded by interest, the abstaining from making certain alterations is also rewarded by interest while the abstaining from making certain further alterations of a similar kind is not rewarded. Those who identify "saving" with such services in production as are rewarded by interest, unconsciously divorce the use of the term from any reference to abstinence or waiting.

The marginal productivity theory of distribution is intended to show how the price of each factor of production is established when the quantity of each factor is given and thus to show how the total product is shared. If interest is to be taken as one of these shares with capital as the factor which receives interest and capital is assumed to be the equivalent of saving there appears to be no intelligible meaning attaching to statements about the marginal productivity of this factor since it is no longer either a quantity of the real capital which jointly with labour gives a product or a volume of abstinence since not all the economically essential "abstinence" is rewarded. This difficulty is thinly masked in the usual presentation of the theory by the adoption of the expedient of treating the quantity of the value of capital as the quantity of the factor capital. By this device new capital has a value equal to its cost, but old capital needs to be continually revalued so that the sum of their valuations will conform to the requirement that interest should appear as its reward. Along these lines we might without inconsistency similarly define the quantities of labour and land in terms of the sums of *their* values. But if this method were openly adopted it

would at once be apparent that the " theory of distribution " belies its title. The adoption of this method in the case of one alone of the factors of production does not make it any the less objectionable.

It is not difficult to see how this confusion has arisen. If a community had a stock of capital, the amount of which remained unchanged, and a flow of labour, there would be a determinate marginal product to each, and the shares of the combined product would be given, provided the capital were eternal. But the share of capital could hardly be expressed as interest, since its quasi-rent would now be a rent. If, however, there were time-discount the owners of capital would be prepared to sell at a finite (instead of an infinite) price, until all of it passed into the possession of those with the lowest discount at higher and higher prices. The return on capital could, therefore, while this redistribution is being effected, be expressed as lower and lower interest on a capital becoming larger and larger expressed as a value, until the final distribution of ownership is achieved. For legitimate marginal productivity theory there has been no change in distribution (except in so far as the supply of labour may have been changed as the result of the redistribution of ownership), while for traditional theory the quantity of capital has increased and its price has fallen, though the absolute shares of the total product remain unaltered.

Let us now suppose that capital in the shape of eternal instruments is somehow or other elastically supplied. Capital will still have at any moment a determinate marginal product given by the stock at that moment, so that we can assign a share of the combined product to each factor. If there were no time-discount the value of capital, if its marginal product has a value, would be infinite and this would be incompatible with any elasticity in its supply. Therefore the value is finite and sufficient to evoke a given

quantity of capital, and this also is impossible if the marginal product still has a value; in other words, the marginal product in equilibrium must be zero. The analysis is therefore incapable of showing how a price, the rate of interest, emerges, whatever assumption we make about the supply of new capital.

A metaphor may make these conceptions clearer. Imagine a reservoir provided with a pipe which admits a flow of labour, and an outflow pipe from which emerges the stream of income, resulting from transformations within the reservoir. The inflow pipe is provided with a tap but not the outflow pipe. The regulation of the tap is one aspect of investment, for we can vary the amount of labour that we admit. But we can also direct the stream so that the transformations that take place within the reservoir are affected. This is the other aspect of investment, that which appears as an alteration in the period of production. This control is exercised by a second, more subtle tap.[1]

The regulation of both these taps depends upon the way in which income is expected to emerge as the result of previous regulation or, what is the same thing, the constitution of what lies in the reservoir, namely, the stock of capital. If there is no change in the flow of labour, and the position of neither tap is being altered, then the constant inflow of labour will eventually lead to a constant outflow of income after a period of adjustment within the reservoir. This is, simply, the change in the constitution of capital from an asymmetrical to a symmetrical structure. As soon as this is achieved, both income as a flow and capital as a stock have become constant, and we have a stationary state. Every movement of the taps initiates an act of investment

[1] If the aggregate flow of labour is altering owing to changes in quantity or quality of population, this will affect both the way in which these taps are regulated and the way in which labour is admitted apart from the regulation by the taps.

or disinvestment, which is complete as soon as the reservoir of capital and the flow of income have changed to give a new equilibrium, while the act of saving or dis-saving is the redistribution of the flow of income over this period of adjustment.

If we believe in effective discount of the future, it is necessary to assume that each tap is provided with a weak spring, that makes it easier to turn it in what may be called the "backward" position and harder in the "forward" position, with the result that some pressure is required even to maintain a stationary state, and greater pressure is required to turn the tap against this force into a new position.

The principal complications of this picture which are required to make it fit the real world result from the non-homogeneity of income and the existence in the reservoir of a stock of land.

We have, so far, seen in general terms how Crusoe will develop on certain simple assumptions. Since development is simply the process of investment, with its consequent saving, and incrementation of capital, is it possible to propound any further generalizations with regard to the investment or saving of such an individual? One point of importance does emerge. The rate of incrementation of capital must, on any reasonable assumptions as to the utility and disutility schedules of such an individual, decline as development proceeds, except possibly for an initial period of great scarcity of income, when both the marginal disutility of labour and the marginal utility of income are very great. It may be uneconomic, at first, to invest more than a trifle, owing to the shape of the relevant part of these schedules, when labour is mainly direct, so that investment may for a time increase, but investment must eventually diminish at a varying rate, depending upon the shapes of

the curves of labour disutility, income utility, and productivity from the use of capital (i.e. productivity expressed as a function of roundaboutness). But the decline of saving will not be as rapid as the decline of investment, owing to the greater amount of saving required for a unit incrementation of capital as capital and the productivity of labour increases; and it is, of course, possible to imagine disutility, utility, and productivity schedules such as will allow periods of increasing saving and even of increasing investment to occur within a development showing, as a whole, a tendency of both investment and saving to decline.

This point is of considerable importance, owing to the widely held assumption that a larger income predisposes an individual to save more than if his income were smaller.[1] Whether or not there is some sense in which this may be true, it is assumed that a community either will or ought to save more as its income increases. If either Crusoe or a community did behave in this way, there would necessarily, in the absence of the development of new wants or any intensification of old wants, be an increasing discrepancy

[1] We have already shown, in the last chapter, that, whatever may be an individual's time-discount schedule (rates of discount of various futures), it is only his discount of the immediate future that could, in an exchange-community, under any assumption, become effective, and there seems little reason to suppose that an increase of income would lower such a discount. This would only be plausible in cases where income is so small as to make the almost immediate future lie altogether outside an individual's consideration. The case is somewhat different for a Crusoe who has a psychological tendency to discount: for such a Crusoe might, as his income increases, lower his time-discount of remote futures, and thus save more for a time as his income increased. Since a closed community, acting collectively, is in a similar position, a lowering of time-discount of remote futures with increase of incomes is conceivable, bringing with it a similar increase of saving, but since it is, in an exchange community, individuals who save, this is irrelevant when we are considering such a community's development, and in so far as the State (the collective side of the community) saves it is not as a matter of fact actuated by considerations of time-discount at all. A collectivist community we may assume would not discount—in the narrow sense (omitting risk and uncertainty) of Chapter II—either the near future, or the remote, for there is no reason to suppose that increasing income is associated with greater rationality in the activity of planning.

between the marginal disutility of labour and the marginal utility of labour's product, a persistent irrationality which would be quite incredible. If increased investment and saving is a normal accompaniment of increasing income we should need the emergence of new wants as a second normal accompaniment of this increasing income to prevent our asserting that human nature is persistently irrational. There is, I think, little doubt that this confusion has resulted from the illegitimate use of supply and demand analysis for the purpose of exhibiting the rate of interest as the price that equates the supply of and demand for saving. As a community becomes wealthier the supply-schedule of saving is supposed on this view to fall (more being saved at any given price) ; and if the demand-schedule for saving fails to rise appropriately, or even falls, the rate of interest must fall. The failure of demand to respond sufficiently must, if continued, cause the rate of interest to fall below 0%, for even a poor community will perform some saving at a positive rate of interest, however low, and, therefore, with the growth of wealth will perform some saving at a negative rate of interest. Since in the stationary state the demand for saving at any positive price is zero, the saving is presumably absorbed by a negative rate of interest, which allows less productive methods of production to be resorted to, until an equilibrium is achieved with an income sufficiently smaller to check this tendency to market the unwanted saving.

It is curious to reflect that this belief in a tendency to oversave is frequently held alongside the belief in a tendency to undersave owing to discount of the future, so that by a judicious belief in a natural psychological harmony, these two irrational tendencies of human nature may be assumed, so it would seem if we accepted this analysis, to counteract one another so as to produce a reasonable compromise.

While Crusoe or a rational community is bound on the whole to show a diminution of investment and saving as

income increases, the saving of particular members of a community will emerge as a consequence of their incomes being greater than the incomes of other members provided we retain the simplifying assumptions of this and the preceding chapter. Let us, then, consider in broad outline how the process of development in the case of an exchange-community as contrasted with a Crusoe-community is affected by the existence of exchange.

The main complication of community-development as compared with Crusoe-development depends upon the variety of utility schedules of the members and the exchanges of capital and income that result from this. We have already seen, in Chapter I, that those members who are the first to abandon direct labour and would have reached a stationary state, in which their saving would cease, if there were no lengthier more productive methods to be adopted, will, as a matter of fact, continue saving and exchange income for capital. Income which would have been consumed by one group is exchanged for capital, which another group produces instead of producing income for itself directly. The second group is thus drawn into the investment process, while the saving necessitated by this investment is performed by the first group. This process continues so long as the second group, which is a diminishing proportion of the community, has a surplus of direct labour which can be persuaded into capital-production without a rise in price. As soon as the second group has become a sufficiently small proportion of the community, direct labour is insufficient to meet the demand of the first group, and the income-value of labour rises, and the rate of interest falls, all labour having now become indirect, and saving by the exchange of income for capital declines. If we assume the existence of longer, more productive methods, it now becomes possible to invest in these. So long as any labour used directly could be diverted to indirect production by the offer of income, this was a more profitable investment for the first group than would

have been the diversion of its own labour into longer period methods, so that these longer methods are, for the moment, excluded. But, as soon as all labour is being devoted to the shortest capitalistic method, a new kind of investment takes the place of the old, and a longer method of production is progressively adopted. And this developmental process will continue to repeat itself with longer and longer methods.

Since the earnings of any period are given by the income plus increment of value of capital, then exchange makes it possible for those members of a community who have invested the last unit of their labour in a longer method of production, to increase their earnings by diminishing their income (i.e. consumption), each unit of income that they sell giving possession of capital which, as it matures, increases in income-value. But investment, at any given rate of interest, can only continue in this way, so long as any labour remains to be diverted to the longer method of production. As soon as the rate of interest falls, the earnings of these savers fall, but income (consumption) increases, and the difference between the two, or the amount of saving, lessens. We see, from this, that although the higher earnings were associated with greater saving, the larger income is associated with less saving. Higher earnings are not the cause of increased saving, but there are conditions in which greater saving leads to higher earnings at the expense of smaller incomes. Development is thus a programme of diminishing investment and saving, with rising earnings and rising income, but a diminishing excess of earnings over income, until in the stationary state earnings and income come to equality.

Although this brief account of development, with the unreal simplifications we have temporarily adopted, may suffice for a general understanding of our theory of capital and interest, the conception is worked out with more rigidity and completeness in the following Appendix.

APPENDIX TO CHAPTER III

In order to exhibit the process of equilibrium-development on the simple assumptions of this chapter we will, temporarily, make a further assumption, namely that for every method with a period of production, P, there is a method one day longer, i.e. of period P + 1 and the ratio of the productivity (defined as the income ultimately accruing from a unit of labour) of this latter method to that of the former method is less than the ratio of their periods of production. We also assume, of course, that a longer method is more productive than a shorter method.

Under these conditions Crusoe will move to longer and longer methods of production, by successive abandonment of shorter methods until, if there is a longest period, he arrives at a stationary state and produces a constant income by this method alone, and at any moment, he is progressively abandoning one method in favour of a method one day longer.[1]

The equations for development through any development period are as follows: Let x be the labour on any day devoted to method (P — 1) with period (P — 1) and productivity C_{P-1}, and y the labour devoted on the same day to method P with period P and productivity C_P:—

md of $(x_1 + y_1)$ [2] = $C_{P-1} \times$ mu of $C_{P-1}x_1$
labour on first day
$= C_P \times$ mu of $(C_P y_1 + C_{P-1}x_2)$, where x_2 is shorter period labour of second day.

md of $(x_n + y_n) = C_{P-1} \times$ mu of $(C_{P-1}x_n + C_P y_{n-1})$
labour on nth day
$= C_P \times$ mu of $(C_P y_n + C_{P-1}x_{n+1})$

[1] This is not strictly accurate for all cases of replacement of shorter by longer methods, for unless the longer methods not yet adopted are integral multiples of the longer of the two methods that are at any moment in use, there will, at each moment when a method has just been abandoned, be a resort for a short period of time to a number of longer methods. This consideration is sufficiently unimportant to be neglected.

[2] In this and subsequent chapters, the phrase " md of " will stand for " marginal disutility of " and refer always to labour; the phrase " mu of " will stand for " marginal utility of " and refer always to income.

and at the end of the period when a stationary state would be achieved but for the fact that a new period of development is initiated in which a still lengthier method of production is progressively adopted

$$\text{md of } y_s = C_P \times \text{mu of } C_P y_s.^1$$

Since there is only one value of y_s which will satisfy this equation, the values of y_s are determined for all values of the constants P and C_P. And, as we have already shown (Chapter I) the values of x and y are determined for each day of a period of development, and, therefore, the whole course of development is determined, given Crusoe's schedules of utility and disutility, and the values of the constants P and C_P for all values of P.

It should be noticed that although the equation for the stationary state at the end of a period of development enables us to calculate the values of x and y throughout the period, the situation envisaged by the equation for the last day does not in fact occur, for, instead of labour falling to y_s, it falls to $y_1 + z_1$ where y_1 (y_X being a new variable for the new "period of development") is the labour devoted to method P on the first day of the new period of development and z_1 the labour devoted to the new method $(P + 1)$.

Let us call the method of direct production one of productivity 1 and period 0, and let any method of period P have a productivity C_P, then in the first period of development (a period of development being defined as the period required for the entire replacement of one method by the next longer method), Crusoe is performing direct labour and indirect labour on every day so as to obtain 1 income to-day per unit of direct labour and C_1 income to-morrow per unit of indirect labour. Therefore the value (i.e. marginal utility) of income to-morrow is $\frac{1}{C_1}$ of the value of income to-day, and the income-value of labour on every day is 1.

[1] If we wish to allow for the possibility of discount, we must multiply the right-hand side of the above equation by $\frac{1}{K^P}$ and $\frac{1}{K^{(P-1)}}$, where K is the discount per day. Since K itself may be a function of P, given by the schedule of discounts of various futures, we ought to use the expressions $\frac{1}{K_P^P}$ and $\frac{1}{K_{(P-1)}^{(P-1)}}$ but this elaboration, required only for Crusoe, may be left to the reader in this and subsequent cases.

As soon as Crusoe enters the second period of development, he applies labour to-day to produce income to-morrow and income the next day, and therefore the value of income two days hence is $\frac{C_1}{C_2}$ the value of income one day hence, and in general, when Crusoe is in any period of development, in which the method of productivity C_P is replacing the method of productivity C_{P-1}, the value of income P days hence as compared with income (P — 1) days hence is $\frac{C_{P-1}}{C_P}$.

The value of to-morrow's income as compared with to-day's income may be expressed either as the income-value to-day of to-morrow's income or the income-value to-morrow of to-day's income. The latter (the reciprocal of the former) we have called the rate of interest for the period of development over which this value relationship holds. The rate of interest thus measures the rate of fall in the value (marginal utility) of income per day, and is equal to the ratio of the productivities of the two methods of production in competition over the period for which it holds.

The income-value of each kind of capital and the income-value of labour are also readily determined, for, if the value of to-morrow's income in terms of to-day's is $\frac{C_{P-1}}{C_P}$, then the value of the next day's income is $\frac{C_{P-1}}{C_P} \cdot \frac{C_{P-1}}{C_P}$ and of the nth day's $\left(\frac{C_{P-1}}{C_P}\right)^n$. Since nth day capital matures into C_{P-1} income in (P — 1 — n) days, if it is (P — 1)-capital or into C_P income in (P — n) days, if P-capital, then the value of nth day capital of either kind is given by

$$\left(\frac{C_{P-1}}{C_P}\right)^{P-n} \cdot C_P$$

and since labour matures into C_P income in P days the present income-value of labour is given by

$$\left(\frac{C_{P-1}}{C_P}\right)^{P} \cdot C_P.$$

When we pass from one period of development to the next, there is a lag of one period of production between the beginning of the application of labour to the new method and the receipt

of income by the new method. Over this period there are three kinds of capital coexisting, (P — 2)-capital maturing from the past, (P — 1)-capital maturing from the past and still being produced, and P-capital beginning to be produced, but the value of income is falling at the rate given by $\frac{C_{P-2}}{C_{P-1}}$, i.e. the rate of interest has not yet fallen; therefore the income-value of capital produced over this period and the income-value of labour rises from the figure given by using the ratio $\frac{C_{P-2}}{C_{P-1}}$ in the above formula to that given by using the ratio $\frac{C_{P-1}}{C_P}$. For example, the value of labour n days (where $n < P$) after it has begun to be applied to the new method is obtained by means of the present income-value of income P days hence, but the value of income (P — n — 1) days hence is $\left(\frac{C_{P-2}}{C_{P-1}}\right)^{(P-n-1)}$ and the value of income P days hence in terms of income (P — n — 1) days hence is $\left(\frac{C_{P-1}}{C_P}\right)^{(P-[P-n-1])}$, i.e. $\left(\frac{C_{P-1}}{C_P}\right)^{n+1}$. Therefore the income-value of labour n days after it has begun to be applied to the P-method is obtained from the expression $\left(\frac{C_{P-2}}{C_{P-1}}\right)^{P-n-1} \times \left(\frac{C_{P-1}}{C_P}\right)^{n+1}$. Since $\frac{C_{P-2}}{C_{P-1}}$ is less than $\frac{C_{P-1}}{C_P}$ (see the assumption of diminishing productivity), i.e. the rate of interest is falling, then, the greater is n, the larger is the above expression.

The value of capital produced during this period will similarly rise with the gradual rise in the value of labour, i.e. not only will new capital, both (P — 1)-capital and P-capital have a higher value on any day than new capital of the previous day (in terms of income on that day), but maturing capital (produced during this production-period) on any day will have a higher value than capital of the same degree of maturity of the previous day.

Thus, a developmental fall in the rate of interest which introduces a new method of production of period P and productivity C_P, is preceded by a gradual rise in the value of labour and P-capital and (P — 1)-capital, produced P days before the fall in the rate of interest, over a period P preceding the fall in the rate of interest. In other words, the structure of production

changes so as to give rise to these value changes and a new stable value situation, whereupon the rate of interest drops to that figure which is appropriate to the new situation. The rate of interest is thus a consequence and not in any sense a cause; but as we shall see later, when, in the real world, there are sudden shifts in development, owing to new inventions, changes in tastes, and so on, it is sometimes convenient to turn things upside down and see how a change in the rate of interest affects the values of capital and the structure of production. Nevertheless, there are pitfalls in utilizing such an approach, as shown by the queer conclusions that can be drawn from an improper use of supply and demand analysis, using the conception of waiting. It is commonly said that the rate of interest is given by the equilibrium of supply and demand of waiting. If, therefore, the community supplies more waiting the rate of interest must fall, which is clearly nonsense, except for a community still engaged in some direct production, for the supply is already determined by past decisions, and the community can make no alteration in its present income or the income of a determinate future period. All that the community can do is to initiate a change in the structure of production so that at some future moment the rate of interest will fall; in other words, to alter the utilisation of resources which would give income at one future date so as to give a different income at a different future date. There can be no such thing as a voluntary increase of waiting by a capitalistic community at the moment of volition, though there can of course be a voluntary decision to commit the community to an increase of waiting in the future; but the waiting when performed cannot be avoided. Keynes, in his *Treatise on Money*, has drawn attention to this point in a different way, but seems to assume that there is some real rate of interest that moves, when the community, attempting to alter its amount of saving, is frustrated by price-level movements. Hayek, in *Prices and Production*, has seen the real significance of the rate of interest when he points out that a change in the rate of interest implies a change in the structure of production. What is really the same point lies at the back of Robertson, Mises, and Wicksell. As will be demonstrated later, the point is of fundamental importance for the theory of money and the trade cycle.

Can we say anything further about the structure of production, apart from the statements of value of the various kinds of

capital? Development has proceeded by the progressive application of labour to more and more productive methods. Labour was first diverted from direct production of income to the method P_1 in increasing amounts every day, and on the day direct labour is abandoned, to-day's income had been provided for, and labour is devoted to producing a larger income for to-morrow by method P_1 and a smaller part of income for the day after by method P_2, thus allowing still more of the next day's labour to be applied to method P_2; so that on each day a larger amount of labour is applied to the more productive method than on the previous day and a less amount to the less productive than on the previous day. Thus, at any moment, when method P and (P — 1) are in operation, we shall find less of (P — 1)-capital the further it is from maturity, and less of P-capital the nearer it is to maturity. The structure of production is necessarily always unsymmetrical in this sense, and would only become symmetrical when a stationary state is reached, with no lengthier more productive method available. If this stationary situation is reached, then the rate of interest is unity (0%), and there are equal amounts of each kind of capital, and the total value of the capital is given by yCP, where y is the daily input of labour, C the productivity, and P the period of production—or, since yC is the daily income, I, the total value of capital is IP. If, owing to time discount we have a rate of interest, then the income-value of the total capital in the stationary state is given by

$$yC\left(\frac{1}{K^P}+\frac{1}{K^{P-1}}+\cdots\frac{1}{K}\right)$$

where K is the rate of time-discount and therefore also the rate of interest. The total value of capital at any moment in the course of development will be given by a considerably more complicated expression since it is a sum of varying values of varying amounts of the different kinds of capital. Since the values of the two competing kinds of capital, the same distance from the labour input, are identical, and since the total amount of labour is diminishing daily, then, if we take the series of pairs of capital of equal value, we have a series of increasing quantities from early to late kinds. At any one moment within a period of development in which two kinds of capital occur, the structure may be graphically expressed as follows:—

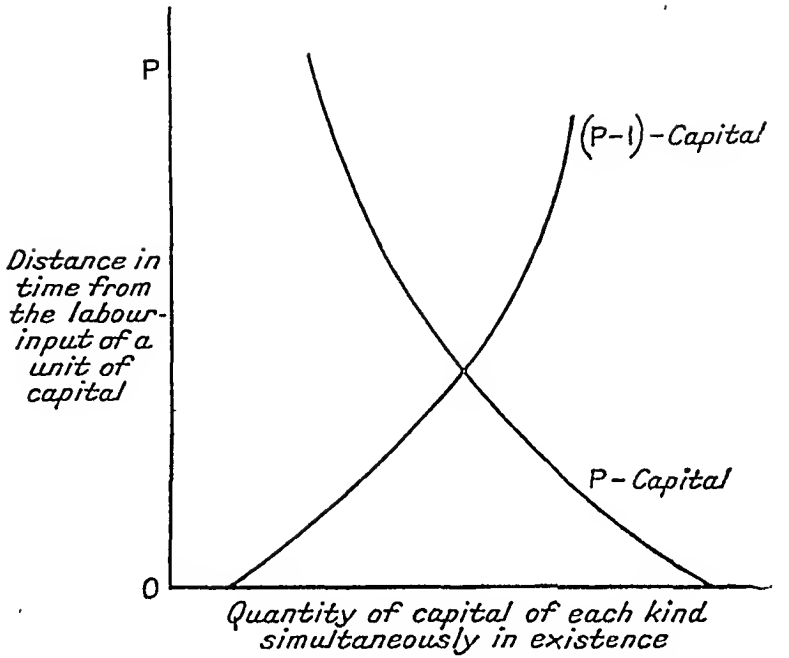

FIG. 1.—The asymmetry of capital during development.

Over a period of development the P-capital curve is moving to the right, while the (P — 1)-capital curve is moving to the left. We may, if we like, regard a period of development as one in which one kind of capital is being substituted for another with a shorter period of production, and in a ratio of less than 1 to 1 [1]; while the increase in the number of kinds of capital of different dates more than offsets this decrease in early as compared with late capital. The main aspects of this process of development are indicated in the diagram on p. 66.

Let us now see how development will take place in a community with free competitive exchange amongst its members, retaining the assumptions of simple labour and income, the absence of co-operative production, and the schedule of simple productive methods we have just investigated. We have already seen (Chapter I) that the rate of interest will fall gradually

[1] To substitute the production of more longer-period capital for less shorter-period capital is, of course, when substitution is appropriate, to substitute more total capital for less total capital.

instead of suddenly as soon as direct labour is abandoned; and this will happen every time the least productive method in a period of development is completely abandoned. At the beginning of this period of fall, those who were the first to abandon the less productive method have been buying new capital cheap; but the price begins to rise and this advantage is progressively

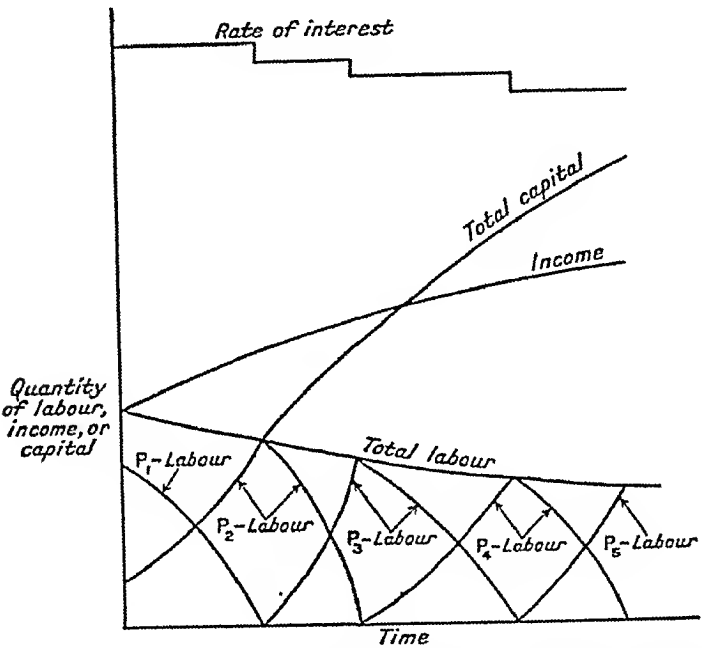

FIG. 2.—The development of Crusoe's Labour, Income, Capital, and Rate of Interest, where P_1-labour is direct labour, and P_2–P_3–P_4–P_5-labour the labour devoted to successively longer period capitals of decreasingly increasing productivity.

lost. If the method just abandoned has a period (P — 1), then what is happening is that early capital is being bought by those who have the most capital for late capital in their possession—only a fraction of the exchanges will be of income for new P-capital, for as soon as one such exchange occurs, the holders of all kinds of capital are out of equilibri ;m until the appropriate exchanges of other kinds of capital take place, those with the

most capital always parting with later capital, i.e. nearer income, for earlier capital, i.e. more remote income. In this way, all kinds of capital become revaluated, i.e. rise in value in terms of income so as to fit the falling rate of interest. Eventually, the rise in value of all kinds of capital reaches the point at which it is advantageous to commence resort to the method of period $(P + 1)$ and the rate of interest has now fallen to $\frac{C_{P+1}}{C_P}$, P days hence, and remains stationary for the remainder of this period of development. Unless we know the allocation of all the utility schedules of the members of the community, we cannot state precisely the length of this intermediate period or the rate of decrease of total labour ; for those who have accumulated most capital are induced at first to work harder and sacrifice present income, as compared with what they would do in isolation, while those who have accumulated least capital are induced to work less hard and enjoy more present income as compared with what they would do in isolation ; but if everyone in the community had this knowledge and behaved rationally, the course of this intermediate period would be precisely determined. Within a development period, however, the course of development is the same whether or not each member has knowledge of the schedules of other members. Therefore, although there is a precise meaning to equilibrium-development for the community through time, the probability of mistakes is much greater than for Crusoe, owing to the occurrence of these intermediate periods. To the extent to which mistakes are made the movement of the rate of interest may be slightly affected, but the principal effect is, of course, on the values of the various kinds of capital, which will have been produced in the wrong proportions so that their values will not correspond to the rate of interest. The rate of interest, or, what comes to the same thing the value of new capital (strictly speaking the value of new P-capital, P days previously), does not give us the values of all kinds of capital existing at the moment, but all the values which they would have but for developmental mistakes. Since, in practice, the developmental movement of the rate of interest is bound to be slow, the deviation of the values of the various kinds of capital from those which are appropriate to the rate of interest is not of much significance even if mistakes of development are as great in practice as we should expect them to be.

Let us now return to Crusoe and drop the assumption that a method of production of period P has a productivity C_P which is less than $\frac{P}{P-1} \cdot C_{P-1}$ (i.e. let us no longer assume a diminishing increase of productivity with increasing period of production), and also the assumption (p. 59) that for every method of production there exists a more productive method one day longer.

If we tabulate the methods of production by simple capital open to Crusoe when he is faced with the necessity of some direct labour, we are bound to find one method which is the most productive in this situation; for any method of period P and productivity C_P may be regarded (so long as there is also some direct labour) as equivalent to a method of period 1 and productivity q, repeated P times, the income obtained each day being regarded as releasing that amount of labour which would directly produce that income.

$$\therefore q^P = C_P$$

i.e. the productivity per day of method P is $\sqrt[P]{C_P}$, and therefore the product at the end of p days is $\left(C_P\right)^{\frac{p}{P}}$.

Therefore, if the productivity Cp of any method of period p is $<(C_P)^{\frac{p}{P}}$ the method C_P is the most productive, and must be adopted by Crusoe at the outset and must prevent the use of all longer methods, so long as Crusoe is performing any direct labour. But it does not eliminate the simultaneous resort to shorter methods. Of shorter methods there will again be one which, being most productive in this sense, will exclude all longer methods which are shorter than P, and so on, until we have selected all shorter methods that are relevant. All these methods will be adopted at the outset simultaneously in determinate proportions, but each will be abandoned as soon as Crusoe is within one production-period by this method of the next longer method, since a bigger income is obtainable on the same day with the same labour by this method than by the shorter method. All these methods are, therefore, abandoned before one production-period by the longest method has elapsed. Let the shorter methods have periods P_1, P_2 . . . and productivities C_1, C_2 . . . then C_1 income at the end of P_1 days is equal in value

(marginal utility) to C_2 income at the end of P_2 days, i.e. P_1th day income $= \frac{C_2}{C_1}$. P_2th day income, or the rate of interest per $(P_2 - P_1)$ days $= \frac{C_2}{C_1}$, or, regarded as an even fall in the value of income (which actually it is not), $\left(\frac{C_2}{C_1}\right)^{\frac{1}{P_2-P_1}}$ per day. And similarly, P_2th day income $= \frac{C_3}{C_2}$. P_3th day income, or the rate of interest per $(P_3 - P_2)$ days $= \frac{C_3}{C_2}$, or, regarded as an even fall in the value of income, $\left(\frac{C_3}{C_2}\right)^{\frac{1}{P_3-P_2}}$ per day, and so on, until we reach the Pth day when no income is accruing from the methods P_1, P_2 . . . and the first instalment of income by the method P appears, with productivity C_P. We now find that 1 income $= C_P$ income P days hence, i.e. the rate of interest is C_P per P days, or regarded as an even fall in the value of income (which actually it is not), $(C_P)^{\frac{1}{P}}$ per day.

Over this first production period P, the rate of interest has been rising until it reaches the figure $(C_P)^{\frac{1}{P}}$ (for a shorter method has a less "equivalent simple productivity" than a longer method), after which it remains stationary for the period of development. We may assume that in subsequent periods of development this consideration becomes of less importance, for the ratio of $(P' - P)$ to P tends to become less as P and P' increase, so that the temporary resort to methods of periods lying between P and P' becomes trifling, and the slight temporary lowering of the rate of interest may be neglected.

It is important to draw attention to a point in connection with the rate of interest which did not arise on our first set of assumptions, where each new method of production was one day longer than the last, thus enabling us to express the value of income on any day in terms of that of the next by means of the ratio of productivities. We are now only able to express the value of income of one day in terms of that of another separated by the difference between the two production-periods. If, for instance, there were no shorter methods of production than

method P, then, over each series of P days, income and labour remain constant, changing on the Pth day, the 2Pth day, and so on. The value of income on any day within one production-period is, therefore, C_P times the value of income on any day within the next production-period, or $(C_P)^n$ times the value of income on any day within the nth production-period. Since the rate of interest per day is the rate of fall of value of income per day, it is unity (0%) for every day except the last of a production-period, and is C_P on the last day, and all kinds

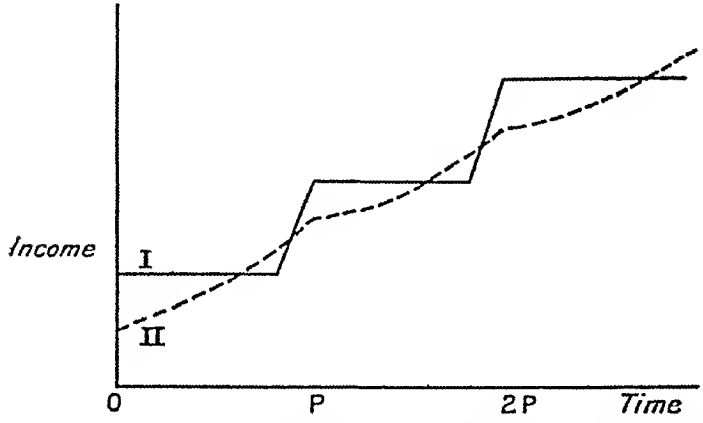

FIG 3.—Crusoe's income during a "period of development". Curve I shows the movement of income on the assumption that there is no temporary resort to shorter methods than the method of period P, when method P is being substituted for direct labour.

Curve II shows the movement of income on the assumption that in the first period of development there is a temporary resort to every method of periods lying between 1 and P.

of P-capital have the same value. Since, however, we can legitimately assume that the lengthening of production must give some increase in product, however small, then, as we have just seen, there will, as a matter of fact, be an increase in income every day of the period P, for a period of 1 day must be more productive than direct labour, and therefore some income will be obtained by this method on the second day, however quickly it is abandoned in favour of longer methods. Instead of daily income increasing in jumps every Pth day, it increases every day.

The above diagram represents the extreme case of productivities

of methods 1 to P being such that the equivalent simple productivity of method (P—n) is greater than the equivalent simple productivity of method (P—n—1), where n is any integer between 1 and P. The rate of interest rises each day, and the curve of income rises continuously. From P to 2P we have a second curve, derived from the first and such that the value of income on day (P + n) is $\frac{1}{C_P}$ the value of income on day n, and from P to 2P, the value of income on day (2P + n) is $\left(\frac{1}{C_P}\right)^2$ the value of income on day n. The rate of interest, therefore, rises over the first period P, then falls to the initial figure and rises over the second period, so that on any day (nP + m), the rate of interest is the same as on the mth day. The value of income on the Pth day is $\frac{C_{P-1}}{C_P} \times$ the value of income on the (P —1)th day, which gives the maximum rate of interest, which falls the next day to C_1 on the first day of the second production-period. In each period of production, the rate of interest moves over the series $C_1, \frac{C_2}{C_1} \ldots \frac{C_P}{C_{P-1}}$, but since each term in the series is greater than the previous term (see the assumption above), while the product of all the terms is C_P, it follows that the earlier terms are $< C_P^{\frac{1}{P}}$ and the later terms are $> C_P^{\frac{1}{P}}$. Therefore, throughout any period of development, the rate of interest at the beginning of each production-period is less than $\left(\frac{C_{P'}}{C_P}\right)^{\frac{1}{P'-P}}$ and rises above this figure, while $\left(\frac{C_{P'}}{C_P}\right)^{\frac{1}{P'-P}}$ is the geometric mean of all these rates. Since, as we move to longer and longer methods, $\left(\frac{C_{P'}}{C_P}\right)^{\frac{1}{P'-P}}$ becomes smaller, the differences in the rate of interest per day become less and therefore approach more and more nearly to $\left(\frac{C_{P'}}{C_P}\right)^{\frac{1}{P'-P}}$.

From this it follows that whatever assumption we make about the rate at which productivity increases with increase in the production-period, development will proceed by first adopting the most productive method (in the sense of that which is the

most productive when reduced to the equivalent shortest period method) and simultaneously all those shorter methods, which are successively most productive in the way we have discussed, and subsequently adopting in succession the next shortest method for which $\left(\frac{C_{P'}}{C_P}\right)^{\frac{1}{P'-P}}$ is a maximum, so that at any moment, only two methods of production are in use. The rate of interest which at first moves somewhat up and down, in the way we have indicated, approximates more and more closely to the figure $\left(\frac{C_{P'}}{C_P}\right)^{\frac{1}{P'-P}}$ for every day in a period of development, P days from the day on which labour begins to be applied to the method P'.

No special qualifications are required in extending this analysis to an exchange-community, for the only complication will still be that of an intermediate period at the end of each period of production when the rate of interest falls gradually instead of abruptly in the way we have already investigated. As regards the structure of production, we shall find the same asymmetry as we found when the difference of period is only one day; and the values of the various kinds of capital will move upwards as the rate of interest falls (and downwards as the rate of interest rises) according to the formulæ we have already developed.[1] No useful purpose would be served by working out the situation in further detail.

[1] The formula for the value of any particular capital is slightly more complicated, since it is the product of a number of rates, unless we assume that these rates have been smoothed out to

$$\left(\frac{C_{P'}}{C_P}\right)^{\frac{1}{P'-P}}$$

Chapter IV

WORKING CAPITAL AND FIXED CAPITAL [1]

From the consideration of simple capital we pass now to the more familiar kinds of capital—working capital to which labour is applied over a number of days, and fixed capital.

Working capital is rarely of the simple form assumed in the last chapter ; more usually it takes the form of a partly-finished product to which labour must be applied over a number of days before it matures into a constituent of income. The complications of the development-equations, necessitated by this more realistic assumption, are given in the Appendix to this chapter, our other assumptions of homogeneous labour and income and the absence of division of labour still being retained.

Since labour applied on a number of days is adding to the income of a particular day, Crusoe is equating a sum of marginal disutilities with the utility of the marginal product on a particular day of these conjoined applications of labour. A decision to increase working capital involves, therefore, an act of investment that may be extremely complex, since labour on a number of days is applied to production, which although lengthier on the whole may be shorter from the point of view of the labour of particular days ; for labour may not be required evenly throughout the growth of a particular piece of working capital. The total

[1] The reader may perhaps find it advantageous to read this chapter without dwelling on the arithmetical details, postponing closer examination until the interconnected ideas of these two chapters have been reviewed and judged as a whole.

act of investment that results from a decision to increase working capital may, therefore, be analysed into a number of investments on each of a number of days, and some of these investments may actually be disinvestments. Net investment is the sum of these investments and disinvestments over the period of production. The accompanying act of saving will, of course, show the same complexity. Thus, in spite of the general decline of investment as development proceeds, the investment of particular days may show considerable variation. Crusoe may even have to work harder on some later days than some earlier days, and may receive less income on some later days than on some earlier days. Since Crusoe must adjust himself to technical facts, equilibrium-development does not necessarily mean an even decline of work and an even increase of income. As compared with a Crusoe-economy, an exchange-economy gives a smoother adjustment to technical facts; and in the real world of diverse methods of production of diverse constituents of income the demand for investment would tend to fall evenly per day, in the absence of new inventions, new wants, and windfalls.

As a concrete example, let us imagine Crusoe to be planting not only one-day fruit-trees but also 30-day trees which require no further labour until the 15th day when, for one day, they require twice as much labour in the way of cultivation as is required for planting; and let us assume that the one-day trees, which require no such cultivation, bear only one-fourth the fruit. On the first day, Crusoe will invest some labour in the new method, i.e. reduce his planting of one-day trees and increase his planting of 30-day trees by a certain amount; and in addition he will disinvest some labour previously applied to one-day trees, i.e. he will reduce his total of work to that extent. For the next 14 days he will behave in the same way, performing no further acts of investment or disinvestment, i.e. he continues to

plant 1-day and 30-day trees in the same way. Since the period of investment is 15 days (i.e. 30—15), we may speak of a rate of investment on each of these 15 days equal to the amount of labour applied on each day to the planting of 30-day trees.

On the 15th day he has to work on the 15-day-old trees, and he will do this partly at the expense of further reducing the planting of one-day trees, i.e. by an act of investment, since the fruit will appear in 15 days instead of in 1 day; and partly at the expense of planting 30-day trees, i.e. by an act of disinvestment, since the fruit will appear in 15 instead of in 30 days; and partly by an increase of labour, i.e. by an act of investment, since fruit will appear in 15 days instead of no fruit at all. This situation persists for a further 15 days, on which there are no acts of investment or disinvestment. But on each day of this period there is a net rate of investment, compounded of two rates of investment and one rate of disinvestment; for there is a 14-day period of investment on account of the change from planting 1-day trees to cultivating 15-day-old 30-day trees, a 15-day period of disinvestment on account of the change from planting 30-day trees to cultivating 15-day-old 30-day trees, and a 15-day period of investment on account of the change from not working to cultivating 15-day-old 30-day trees. On the 30th day, the fruit of the 30-day trees begins to appear, so that an act of investment occurs in the form of an increased planting of 30-day trees in place of 1-day trees; and there is also an act of investment in the form of further planting of 30-day trees instead of cultivating 15-day-old 30-day trees, owing to the reduced number of 30-day trees planted 15 days previously; while, finally there is an act of disinvestment which takes the form of a decrease of labour in the cultivation of 15-day-old trees. The rate of investment on each subsequent day, resulting from these acts of investment and disinvestment, can again

readily be calculated by reference to the periods of investment of each act of investment.

The above example is comparatively simple, and the net rate of investment on any day is easily discovered. In more complex cases, new acts of investment and disinvestment are likely to occur, while a rate of investment still continues from early acts of investment, so that the net rate of investment on any day may be a matter of very complex calculation. There is no escape from this difficulty; and it must be recognized that the rate of investment on any day cannot be discovered by a study of the way in which labour is being utilized on that day or even by a comparison of the way in which labour is being utilized on that day with the way in which it was utilized on the previous day. If, however, we accept the picture often naïvely taken for granted, labour being for practical purposes utilized in two and only two sharply differentiated ways, on the one hand to produce income by working with capital instruments, on the other hand to produce more instruments, then on any day the labour devoted to the production of instruments may be regarded as the rate of investment on that day only if we make a serious omission. The greater the stock of instruments the greater will be the amount of labour required for utilizing them; so that either more and more labour must come into existence as the stock is growing (which is absurd), or the growth of the stock must be checked and labour be diverted from the continued production of instruments, i.e. suffer a shortening of the period of production. The rate of investment given by the production of capital instruments must be accompanied by a rate of disinvestment consequent on the use of an ever-increasing stock of such instruments. Therefore, even with this naïvely simplified picture of production, the rate of investment could not be calculated, unless we knew by how much labour had been diverted from the production to the

utilization of capital as compared with the amounts used in both ways on the previous day, so that time (in the shape of period of production) again enters into our calculation of the net rate of investment on any particular day.

It is in the case of fixed capital that we find the greatest degree of complexity in the act of investment. For it is a peculiarity of the kind of fixed capital that is everlasting so long as it is properly maintained that the act of investment is in a sense never complete and involves a series of acts of disinvestment through the need of transferring labour from the work of construction to the work of maintenance and utilization.

The essence of fixed capital lies in the fact that income is produced on a number of days from the previous application of labour. (Working capital, on the other hand, requires labour on a succession of days to yield income on a particular day.) If we take a very simple form of fixed capital, we may suppose that labour on one day gives rise to a given amount of income on each of a definite number of later days. Thus in the case of a piece of furniture produced on one day, we may suppose that the labour of one day gives rise to a given amount of income (amenities) on each of a number of later days. Developmental equilibrium requires, therefore, that the marginal disutility of labour on the first day be equated with the sum of utilities of the marginal product on each of the days on which the income accrues. A quite determinate development, therefore, results.

But what now is meant by the period of production and what is to be understood by the quantity of capital after it has commenced to disappear as income? Let the total quantity of income from one unit of capital be I, and let this be distributed through successive days in proportions $w_1, w_2 \ldots$ Then, on any day, when $(w_1 + w_2 + \ldots w_x)$ income has already been delivered, we shall define the

quantity of capital[1] as $\frac{I - (w_1 + w_2 \ldots + w_x)}{I}$ and if p_1, $p_2 \ldots$ are the periods elapsing between the original production of our unit of capital and the appearance of incomes, w_1, $w_2 \ldots$ then the period of production is defined as $\frac{w_1}{I} \cdot p_1 + \frac{w_2}{I} \cdot p_2 + \ldots$, or, in other words, $\frac{w_1}{I}$ units of labour have a period p_1, $\frac{w_2}{I}$ units of labour have a period p_2, and so on.

This procedure is arbitrary; for what we really have is a joint supply of incomes of different dates, and therefore we cannot attribute the income of any particular date to any particular part of the original labour. This we admit; but it is also true that however we assign the income of a particular date to any given amount of the original labour, the pursuit of the method of this book leads to identical conclusions with regard to the way in which such capital is built up, and identical conclusions with regard to relative values and the rate of interest (all this being on the assumption that capital is not maintained). A reference to the Appendix to this chapter where no assumption as to the periods of production of the labour of construction is made, will make this clear. But if capital is maintained arbitrariness disappears; for the labour of maintenance restores capital to its original condition, and therefore, prior to maintenance, capital must have diminished by an amount equal to the labour of maintenance, and this assigns a period to a portion, but a portion only, of the whole labour of construction, a portion equal to this labour of maintenance. To the remaining labour of construction the infinite income of the future that appears if maintenance continues has still to be assigned. Since a similar situation

[1] Except when the limitation given by the following pages introduces a correction.

recurs on every day, capital being restored to the same state by the same amount of labour, it follows that only an infinitely small amount of the product of this remaining labour of construction may be said to disappear as income (an infinitely small amount of the labour being " used up ") on each day,[1] and the period of production of each infinitely small amount of labour is given by the series of cardinal numbers stretched to infinity. It is therefore only in the case of fixed capital that is allowed to depreciate that there is any arbitrariness in the conception of a period of production of the labour of construction. This arbitrariness can, however, in many cases be limited further, if there is a

[1] We are here taking the limiting case of capital which can be perpetually maintained, although in practice such capital is rare, because the cost of maintenance rises or the efficiency of the capital declines. Therefore, in practice, instead of an infinite number of infinitely small quantities of labour with periods from 0 to ∞, we have a finite number of very small quantities of labour with periods from 0 to a large finite figure.

A common case, in practice, is that in which, although the daily cost of maintenance may remain unchanged, the physical operation of maintenance is different on each day, now replacing one part of the machine, now another, until after a finite time no molecule of the original machine may remain. From the standpoint of economics this is an irrelevant consideration and we do not need to throw over the conclusion that the income from the machine continues to be the combined product of some of the original labour of construction as well as of the labour of maintenance. Cases may, however, arise where a choice has to be made between partial and complete maintenance, and, owing to the fact that the physical operation of maintenance may become different at different ages in the life of a machine, a given amount of labour applied to partial maintenance may make the potentiality to deliver future income different at one age of the machine from what it would have been at another age.

Where maintenance of capital obviously includes considerable reconstruction, an alternative treatment of the problem is possible by analysing the labour of maintenance into " labour of restoration " and " labour of reconstruction ". If any part of the machine takes a time " t " to wear out, the labour that can be ear-marked to the production or reconstruction of that part may be said to have a period " t ". Thus each unit of the original labour of construction will have a definite finite period, as also each unit of the labour of maintenance. This, however, is to import into economics technological facts which should be introduced only in the form of cost-schedules. Given the cost-schedules of full and of every degree of partial maintenance for each day in the life of a machine, the production-factor of the labour of each day is given, even though it must be revised whenever intentions are changed. And, what is more important, the rate of investment is unambiguously given at any moment, changing in a determinate way as soon as changed intentions are realized in changed behaviour.

finite cost of maintenance at any stage of depreciation and/or a finite cost of replacement [1] at any stage of depreciation. For example, let there be 4 stages of depreciation and let 10 units of labour produce a capital which delivers the income-series 10, 6, 3, 1, on successive immediately succeeding days. Let the cost of maintenance at each stage be 6, 5, 4, 2, units of labour respectively, and let the cost of replacement at each stage be 10, 8, 6, 4, respectively. Then capital must diminish at each stage by less than 6, 5, 4, 2, and the amount of capital at each stage must not be greater than 10, 8, 6, 4, at each stage, i.e. at the first stage of depreciation it must be $> 10 - 6$ and not > 8, and at the second stage it must be $> (> 10 - 6) - 5$ and not > 6, and at the third stage it must be $> [>(> 10 - 6) - 5] - 4$ and not > 4, and at the last stage it must be 0.

It must be emphasized that this is only a limitation of arbitrariness,[2] which is unlikely to enable us to give a complete assignment of the labour of construction to the income of any particular date. If a piece of capital cannot at any stage of depreciation be replaced and cannot at any stage be maintained, we are at liberty to assign the income received to the labour of construction in any way we please. We choose to assign equal amounts of income to equal amounts of labour merely for convenience.

It may be suggested that situations can arise in which capital has depreciated and is quantitatively greater than some given figure, owing to the schedule of maintenance costs and yet the cost of reproduction is less than that figure. This, of course, implies a mistake or a new invention, and is best treated as a revision of the act of investment, the amount of such capital being given by the cost of

[1] i e. a finite amount of labour required to produce the capital at any given stage without delay.

[2] A similar arbitrariness in dealing with the problem of " common costs " is customarily admitted. See, for example, Marshall, *Industry and Trade*, 1919, pp. 192–4.

reproduction. Labour has been thrown away. This is only a particular form of the problem of misdirected labour. If 10 units of labour are devoted to the production of a capital which one unit of labour can produce under the same conditions and at the same time, we have 1 unit, not 10 units, of capital. It is inconvenient to assume that exactly similar things can be quantitatively different. Therefore the labour in a piece of capital can be subsequently destroyed by a new invention, just as it can be destroyed by the capital's destruction by fire; and a mistake can obviously be treated as the equivalent of a conflagration.

A more complex form of fixed capital results from the application of labour over a number of days, income appearing over a number of later days. This requires a more complex calculation for Crusoe or the members of a community, for it is now a sum of marginal disutilities of labour which must be equated with a sum of utilities of the marginal product on a number of days (for income over a period is the joint product of conjoint applications of labour over a period). No difficulty of principle is involved, and a quite determinate development results.

If, however, income can continue to be secured indefinitely by the continued application of labour to a piece of fixed capital, we have the much more complex case of what is ordinarily understood by fixed capital. Crusoe's calculation of the appropriate investment on any day requires the balancing of an infinite sum of marginal disutilities of labour against an infinite sum of marginal utilities of income. As shown in the Appendix to this chapter, the process of replacement of direct labour by such a fixed capital method is quite determinate, and would be associated, not with a constant rate of interest followed by a fall, as in the case of working capital or simple fixed capital, but with a rising rate of interest, and investment and saving would increase with increase of income instead of diminishing.

The tendency of the rate of interest to rise, as a fixed capital method replaces a simpler method of production, gives the clue to the most significant peculiarity of fixed capital, namely, that the income-value of the labour necessary to maintain it and utilize it is necessarily less than the income that accrues from it, so long as the stationary state has not been reached. I am not, of course, referring to fixed capital which it is intended to discard, for this may be regarded as a simpler form of fixed capital, requiring a finite number of labour applications and a finite number of transformations into income. And I am not considering the risk of obsolescence due to new inventions, which may, as a matter of fact, reduce the rate of investment in the real world.

It is when we come to fixed capital that requires labour of maintenance, or labour both of maintenance and of use, that problems arise, which have led many economists to ridicule a theory of capital, based on productivity and production-periods alone.[1] In order to make it clear that the difficulties are only apparent, a preliminary analysis is required.

Fixed capital may involve labour in the following ways :

(1) labour of construction,

(2) labour of use,

(3) labour of maintenance on account of deterioration through time,

(4) labour of maintenance on account of use.

[1] See e g Professor Knight's criticism of Professor Hayek and the whole Austrian school. Knight, " Professor Hayek and the Theory of Investment," *Economic Journal*, 1935.

Our lengthy treatment of limiting cases in a highly abstract way is rendered necessary by the fact that unless a period of production can be assigned to every unit of labour on every day, the conception of capital, which this book is endeavouring to sustain, falls to the ground. It must however, be remembered that it is not essential for the conception that the period of production be irrevocably given at the moment labour is utilized in any given way.

Each of the above kinds of labour has a period (not to be confused with what we have hitherto called and will continue to call the period of production—the period, that is, that comes to an end with the passage of capital into income) and definable as follows :

(1) Period of construction, i.e. the sum of the periods of each unit of the labour of construction up to the moment of the completion of the construction.

(2) Period of use, i.e. the period from the moment of application of the labour of use to the moment of delivery of the consequent instalment of income.

(3) The period of time-maintenance, i.e. the period from the application of labour of maintenance to the delivery of the corresponding instalment of income.

(4) The period of use-maintenance, i.e. the period elapsing between the application of labour of maintenance to the delivery of the corresponding instalment of income.

As will presently become clear the periods of production may be greater than the above periods, except in the case of use-labour, but cannot be less.

Let us first take the simplest case in which all the above periods are zero (i.e. less than one day), and let us assume that there is no labour of use (i.e. the capital is pictured as budding out income without further labour). We take first the case of the stationary state, and assume no time-discount. Capital is maintained and not produced, if the productivity of maintenance is greater than the productivity of construction in the absence of maintenance : if less, it is produced at a constant rate and not maintained.[1] For example, let 10 units of labour produce capital which

[1] If a house gave much the same utility every year and collapsed suddenly at the end of ten years if not maintained, but could be maintained indefinitely by repairs costing per annum $\frac{1}{10}$ of the cost of construction, then, in the absence of time-discount, a slight increase in the cost of maintenance would make it uneconomical to undertake any repairs, while a slight decrease would make it uneconomical ever to have a new house.

delivers on successive days 10, 6, 3, 1, of income, then the productivity of construction-labour in the absence of maintenance is 2, i.e. $\frac{10+6+3+1}{10}$. Let 5 units of labour be required for maintenance, then 5 units are responsible for 10 units of income, i.e. $(10+6+3+1)-(6+3+1)$, the difference between the situation with maintenance and without maintenance, i.e. 10 income instead of 6 on the first day, 6 instead of 3 on the next, 3 instead of 1 on the next, and 1 instead of 0 on the next. The productivity is, therefore, 2. If, therefore, more than 5 units of labour are required to maintain the 10 units of capital, maintenance will not occur, and capital will be constantly produced. If less than 5 units of labour are required for maintenance, capital will be maintained. Now, such capital if maintained in the stationary state is, of course, perpetually maintained, so that the production-factor of the labour of construction of the capital which is taken over by the stationary state from the previous state of development is necessarily infinite; for on each delivery of income only an infinitely small proportion of the labour of construction is "used up" (i.e. its product disappears as income). The labour of construction consists of an infinite number of portions with periods of production ranging from 0 to ∞, so that the average period is infinite in the sense in which the average of the infinite series of cardinal numbers is infinite.[1]

[1] If capital were perpetual and required no maintenance no one would dispute this analysis, though it may be doubted whether any such capital exists. It is, however, quite clear that many forms of capital exist which do not deteriorate at all provided some comparatively simple act of maintenance is performed at regular intervals, e.g. keeping down vegetation on an artificial embankment. This necessity for maintenance would not be a valid reason for making the "average" period of production of the original labour of construction finite instead of infinite. (See also p. 78. In any case, since for analytical purposes the limiting case of "perfectly simple capital" has often been taken as admissible, however non-realistic the idea may be, the corresponding limiting case, equally required for pure analytic purposes, may reasonably also be accepted as admissible.

Since we have assumed no time-discount in the stationary state, the period of production either of construction-labour (if capital were allowed to depreciate), or of maintenance-labour (if capital were not allowed to depreciate), has no bearing on the question of whether capital will be maintained. If, however, we assume time-discount, maintenance no longer turns simply on productivity. Let the labour of maintenance be less than 5, e.g. 4·5, so that, in the absence of time-discount, there would be maintenance and let the discount be K per day. Maintenance will now occur only if the expression

$$\frac{10-6}{4\cdot5}+\frac{6-3}{4\cdot5}\cdot\frac{1}{K}+\frac{3-1}{4\cdot5}\cdot\frac{1}{K^2}+\frac{1-0}{4\cdot5}\cdot\frac{1}{K^3}$$ which may be put $$\frac{4}{4\cdot5}+\frac{3}{4\cdot5}\cdot\frac{1}{K}+\frac{2}{4\cdot5}\cdot\frac{1}{K^2}+\frac{1}{4\cdot5}\cdot\frac{1}{K^3}$$ is greater than the expression $$\frac{10}{10}+\frac{6}{10}\cdot\frac{1}{K}+\frac{3}{10}\cdot\frac{1}{K^2}+\frac{1}{10}\cdot\frac{1}{K^3}$$ which may be put $$1+\frac{6}{10}\cdot\frac{1}{K}+\frac{3}{10}\cdot\frac{1}{K^2}+\frac{1}{10}\cdot\frac{1}{K^3};$$

for each of these expressions gives the present discounted utility of the marginal product of current labour devoted to maintenance or to construction respectively.

The nearer K is to unity in the above expressions, the greater is the reduction of the first expression as compared with the second.

Not only may time-discount prevent maintenance which would occur in the absence of time-discount, but time-discount may cause maintenance instead of construction which would occur in the absence of time-discount. The situation in the latter case must be one in which maintenance is less productive than construction (in the sense given on p. 84) while the " average " period of production (in some sense to be elucidated) of maintenance-labour is

less than the "average" period of production of construction-labour. The discount which is just sufficient to bring about maintenance can be calculated in precisely the same way as in the above example. Since, during development, the rate of interest is trending downwards, fixed capital may have many different destinies quite apart from mistakes; for one kind may at first be constructed afresh each day and only be maintained when the rate of interest has fallen sufficiently to call for the lengthier but more productive method of maintenance; while another kind may be maintained only until the rate of interest has fallen sufficiently to allow the more productive but lengthier method of new construction every day.

It will now be clear that the quantity of maintained capital in the stationary state will necessarily be just such a quantity that there will be no inducement to increase the amount, and its marginal utility being therefore zero, the value will be zero whether or not there is time-discount.[1] (Such permanent capital, for many purposes, is indistinguishable from land, but from the valuation aspect, the two are sharply contrasted.) In other words, the amount of such capital in a stationary state is not a function of its productivity, but only of the productivity and, if there is discount, of the period of production (in some sense) of maintenance-labour. This readily follows from the fact that if the marginal disutility of maintenance-labour is less than the discounted utility of the marginal product, the state is not stationary and further fixed capital must be produced; and therefore an infinite future shows the same finite discrepancy, which must be corrected by some production of capital, however small. It is true that as we approach the position in which the quantity of capital

[1] Since we have assumed a zero period of construction (see p. 83) the total stock of capital is capital awaiting maintenance. The value of capital at the moment it is maintained and about to deliver income is, of course, the cost of maintenance.

makes the marginal disutility of maintenance-labour become equal to the discounted utility of the marginal product, the rate of production of fixed capital diminishes so that the rate of approach is asymptotic and a stationary state is only fully attained after an infinite time. But this does not affect the conclusion that if the state is assumed to be stationary, the production of fixed capital has come to an end and there is no motive to produce any more. We may, therefore, regard the fixed capital of a stationary state as that heritage of wealth in this form, which such a state will continue to maintain intact. The question we are, in effect, answering when we ask what will be the stock of maintained or non-maintained but perpetual fixed capital in a stationary state, is simply the question of what precise stock of such capital freely handed over to such a community will be kept intact. (In the case of non-maintained perpetual fixed capital we should need to substitute the word *minimum* for *precise*.)

If cost of maintenance of any particular capital be zero, the quantity of such capital in the stationary state will not only be independent of productivity but also of time-discount, and its value will, of course, be zero. This follows from the fact that the product of any finite amount of past labour embodied in such fixed capital is infinite and no finite discount can prevent the sum of discounted future utilities increasing as we increase the number of terms.

At the other extreme we have capital which is incapable of delivering any income unless maintained, (i.e. depreciation is infinitely rapid), and here again we find that the quantity of capital in the stationary state will not only be independent of productivity but also of time-discount. The reason for this is the zero "period" (in the special sense of p. 83) of the labour of maintenance, which, together with the productivity of maintenance, determines the amount of capital which is consistent with stationariness.

Between these two extremes we have maintenance-labour

with some finite " period " (as above), so that time-discount will affect the amount of capital.

We have shown precisely how maintenance or non-maintenance in a stationary state with or without time-discount turns on considerations which do not presuppose an allocation of periods of production to the labour of construction or maintenance. But we have seen that, if there is time-discount, there is some sense in which the situation is dependent on periods of production; and since we have also shown (see Chapter III) that the amount of capital is equal to the net production-factor of current labour,[1] i.e. Σlp, it is necessary to assume that periods of production can be allocated to labour.

Let us first take the case of non-maintained capital, then production-periods can be assigned in any way that preserves the limitations given on pp. 79 *seq.* If as between two possible allocations we choose that which gives a greater production-factor, we are choosing to assign a larger figure to the quantity of capital at a particular stage or stages of depreciation, but we are necessarily preserving equality between the quantity of capital and the net production-factor. For example, if capital of this type (indicated on p. 77) delivering the income series 10, 6, 3, 1, from 10 units of labour expended on its production, is regarded as $\frac{20-10}{20}$ of 10 units of capital at the first stage of depreciation, $\frac{20-10-6}{20}$ of 10 at the second, $\frac{20-10-6-3}{20}$ of 10 at the third, and $\frac{20-10-6-3-1}{20}$ of 10 (i.e. 0), at the fourth, then the production-factor of 10 units of labour is

[1] i.e. the capital which the community's current labour produces—a qualification rendered necessary to cover the fact that a stationary state does not produce the maintained fixed capital which it utilizes. The significance of this point will become clear later.

$\frac{10}{20}$ of $10 \times 0 + \frac{6}{20}$ of $10 \times 1 + \frac{3}{20}$ of $10 \times 2 + \frac{1}{20}$ of 10×3 (assuming a zero period of construction, see p. 83), i.e. $0 + 3 + 3 + \frac{3}{2}$, i.e. 7·5, so that if 10 units of labour are in this way expended daily in the stationary state, there will be 7·5 units of capital. But there will necessarily be a stock of capital at each stage of depreciation—none undepreciated (owing to the zero period of construction) 5 units at the next stage, 2 at the next stage, ·5 at the next stage, and 0 at the last stage—a total of 7·5. If we had chosen to allocate more of the labour to early income, the production-factor would have been reduced by precisely the reduction in the quantitative statement of the stock of capital.

It may be noted that this situation is in part a consequence of definitions. If we had chosen to define the quantity of capital as the amount of income into which capital matures instead of defining it as an amount of embodied labour, the same problem of allocation would arise in the case of working capital, e.g. if we had to work on a bottle of wine every day to its maturity, we could allocate the income contained in a bottle as we like; but what we might now call the maturity-factor corresponding, *mutatis mutandis*, to our production-factor would necessarily supply us with a figure for the amount of capital which enables us to be consistent. The symmetrical stock of wine of different ages, it should be noticed, is the structure of production corresponding to the symmetrical stock of capital at different stages of depreciation. It would be an interesting check on the argument of this book to define the quantity of capital in this way as the quantity of income into which it matures, so that instead of investigating the income-value of labour and capital we should be investigating the labour-value of income and capital. In this book the time-labels on capital are dated from the input of labour; on this alternative

treatment, the time-labels would be dated from the delivery of income—and quantities of capital which would be equal on the one system would be unequal on the other system. One advantage of this alternative treatment would be that it would exhibit the quantity of capital in a stationary state as a function of income and maturity-periods, without having to exclude the heritage of fixed capital which is not produced by labour in the stationary state.[1] For, provided we assume the stationary state to be eternal, all the income from fixed capital, though this income is infinite in amount, may be considered as delivered within this infinite period, provided the capital is eternal or perpetually maintained. The quantity of such capital when measured in this way is therefore infinite. On this system, the quantity of capital in the stationary state would be given by Σip where i is the quantity of income and p its maturity-period.

We have now seen that it is a matter of no consequence how we assign production-periods to the labour of construction of fixed capital, so long as we preserve the limitations given by the schedule of maintenance-costs and the schedule of reproduction-costs (and even this is only a matter of convenience to avoid the awkwardness of having capital which properly continues to be produced and yet, if produced in a different way, e.g. by reproduction, would have to be regarded as less in quantity, since embodying less labour). In the above example, since 5 units of labour give maintenance (see p. 84) 10 units of new capital immediately become 5 units (on the assumption of no period of construction) and therefore 5 of the 10 units of labour have a period of production of 0, while the remaining 5 units, if capital is maintained, have periods ranging from 0 to ∞. The "average"[2] period of production is, therefore, ∞,

[1] See pp. 95 seq.

[2] "Average" is here a weighted average, such as we use for index-number purposes, i.e. $\frac{5\times 0+\frac{1}{\infty}\times 1+\frac{1}{\infty}\times 2+\ldots\frac{1}{\infty}\times\infty}{10}$

but a smaller order of infinity from the ∞ of any particular production-period we like to take.

If, however (in spite of the fact that 5 units of labour could give complete maintenance), the capital is not maintained, but allowed to depreciate and be replaced by new construction as the more appropriate method, it still remains true that 5 units of the labour of construction have a period 0, while the remaining 5 units have periods 1, 2, 3 days for the incomes 6, 3, 1, that appear on successive days, which gives us $\frac{6}{10}$ of 5 units of labour having a period of 1, $\frac{3}{10}$ of 5 with a period of 2, and $\frac{1}{10}$ of 5 with a period 3, on our arbitrary principle of allocation. The production-factor of the 10 units is therefore $10 \times 0 + \frac{6}{2} \times 1 + \frac{3}{2} \times 2 + \frac{1}{2} \times 3$, i.e. 7·5. If maintenance[1] at other stages of depreciation is impossible or cost unduly high and reproduction at any stage of depreciation is impossible or cost unduly high, there is no need to modify the above figures and the "average" period of production can be regarded as $\frac{7 \cdot 5}{10}$, i.e. ·75.

If capital is fully maintained, we still have to assign periods to the labour of maintenance. 5 units of maintenance-labour give (10 — 6) income on the same day (since we are assuming a zero period of maintenance), 6 — 3 on the next, 3 — 1 on the next, and 1 — 0 on the next. Our arbitrary principle gives therefore an allocation of periods of 0 to $\frac{4}{10}$ of the labour, 1 to $\frac{3}{10}$, 2 to $\frac{2}{10}$, and 3 to $\frac{1}{10}$, so that the pro-

[1] It is possible that the costs of maintenance at various stages of depreciation required in each case to restore the capital to the next earlier stage may, as a schedule, show great irregularity; as may also the schedule of income-yields. If such cases have to be dealt with, the arithmetic has to be complicated, but the principle remains unchanged.

duction-factor of the 5 units is given by $\frac{4}{2} \times 0 + \frac{3}{2} \times 1 + \frac{2}{2} \times 2 + \frac{1}{2} \times 3$, i.e. 5, so that the "average" period of production is $\frac{5}{5}$, i.e. 1. This allocation, again, only requires modification, if maintenance-costs or reproduction-costs at later stages of depreciation are sufficiently low.

Let us now take the case of fixed capital that requires labour of use and, unless maintained, depreciates as the result of use and through the lapse of time. If such capital is not maintained, we may reasonably assume either that the income from an unchanged amount of use-labour per day diminishes in some determinate way, or else that an increasing amount of labour per day is required to obtain an unchanged income per day as the capital depreciates. Let us, for example, assume that 10 units of labour produce a capital which requires a daily use-labour of 1 unit and, if not maintained, yields an income of 10, 6, 3, 1, 0, units, and let 5 units of labour suffice for full maintenance. If not maintained, the series 10 + 1, 1, 1, 1 units of labour on successive days gives the series, 10, 6, 3, 1 income on the same series of days. But, if maintained for one day only, 10 + 1, 5 + 1, 1, 1, 1 units of labour would have given 10, 10, 6, 3, 1 units of income. Therefore, 5 units of labour now and 1 unit 3 days later have added (10 − 6) of income now and (6 − 3), (3 − 1), (1 − 0) on subsequent days. The productivity of maintenance + use labour is, therefore, 10 units of income for 6 units of labour. Now, if we keep to the assumption that the period of use is zero, the period of production of use-labour is also zero, since use-labour is, under this assumption, only adding simultaneous income. If, when depreciation is allowed to occur as above, we assign the last unit of income to the last unit of labour of use,

the productivity of maintenance-labour, in the above illustration, is given, and this enables us to calculate what would be the "average" period of production, if maintenance-labour were continuously applied. If depreciation were a gradual and continuous process, this procedure would obviously be justified; and even in the example given, the effect of this discontinuity on the calculation of the "average" period of production of maintenance-labour is negligible (even if we assume that the productivity of the last unit of use-labour is less than the upper limit of 1 in the above example).

The question of whether or not maintenance occurs in the stationary state depends, therefore, upon precisely the same considerations of productivity of use-labour and maintenance-labour and "average" period of production of the latter (if the period of use is zero), as compared with the productivity and production-periods of labour of construction, if capital continues to be newly-constructed instead of being maintained. If there is no discount, the difference of productivity alone is relevant. In the above example the productivity of labour, if the capital is not maintained is

$$\frac{10 + 6 + 3 + 1}{(10 + 1) + 1 + 1 + 1}, \text{ i.e. } \frac{20}{14},$$

while the productivity of labour, if there is maintenance, is $\frac{10}{6}$, which is greater than $\frac{20}{14}$, and therefore in this example there will be maintenance. If there is discount, K, there will be no maintenance if the expression

$$\frac{10 + 6\frac{1}{K} + 3\frac{1}{K^2} + 1\frac{1}{K^3}}{14} \div \frac{11 + \frac{1}{K} + \frac{1}{K^2} + \frac{1}{K^3}}{14}$$

is greater than

$$\frac{(10 - 6) + (6 - 3)\frac{1}{K} + (3 - 1)\frac{1}{K^2} + (1 - 0)\frac{1}{K^2}}{9}$$

$$\div \frac{6 - \frac{1}{K} + \frac{1}{K^2} + \frac{1}{K^3}}{9};$$

for the first expression is the discounted income from a unit of labour divided by the unit of labour discounted for its time distribution, on the assumption of depreciation, while the second expression is the discounted income from a unit of labour divided by the unit of labour discounted for its time distribution, on the assumption of maintenance.

Therefore, if capital is maintained, its value before maintenance will, in the stationary state, again be zero ; and the amount of it will not depend upon its marginal productivity, but only on the productivity of use + maintenance, as well as on the periods of production of the labour of maintenance, if there is time-discount.

If either the cost of maintenance is zero or, on the other hand, if after use or the lapse of time it so depreciates that it cannot again be used until maintenance-labour is applied, even time-discount will have no effect on the quantity of capital, and the value of the capital, before maintenance, will be zero.[1]

We have, in this treatment, neglected one important practical point in order to make the problem manageable. We have neglected the possibility of partial maintenance. (In practice full maintenance is rare, capital being allowed to depreciate at least to some extent.) If we know the schedules of depreciation and of cost of all degrees of partial maintenance at each stage of depreciation, the rate of maintenance or allowance of depreciation will be precisely given, and partial maintenance may be more productive than full maintenance or full depreciation, so that a stationary state with partial maintenance is likely, when, with only alternatives of full or no maintenance, the stationary state would

[1] For a different view, see Pigou, *Economics of Stationary States*, pp. 53–4, where the quantity and value of fixed capital in a stationary state are supposed to depend on considerations of productivity and discount.

be one either of full maintenance or in other cases one of constant new production. Time-discount will also affect the question of whether there is partial maintenance and the degree of it. It is also in connection with the possibility of partial maintenance that the importance of the distinction between time and use maintenance arises, for the schedule of maintenance-costs at different stages of depreciation may make a partial use preferable to full use.

One other simplification may now be removed. We have assumed zero periods of construction, use, and maintenance. These may, in practice, be of any length, and affect the amount of capital in the stationary state in obvious ways. If capital is maintained, the " period " of construction has no effect whether or not there is discount ; but if capital is not maintained, a period of construction greater than zero reduces the amount of capital if there is discount, and enters into the consideration of whether or not capital is to be maintained. Similarly, with positive periods of use and maintenance, there is some effect if there is discount, but as regards these periods, since they are likely to be comparatively short, the effect on the amount of capital will be trifling.

We are now in a position to reassert the proposition that the quantity of capital in a community is always a function of the net production-factor of labour, so that, given the amount of labour, the amount of capital is a function of the period of production. It is necessary, however, to guard against certain confusions, which have allowed propositions even less extreme than the above to receive scant respect from the majority of economists outside the Austrian school.[1] Let us first take the stationary state. In this, if no capital is perpetual or perpetually maintained, the capital in existence is obviously equal to the net production-factor

[1] *Vide* Knight, " Professor Hayek and the Theory of Investment," *Economic Journal*, 1935.

of the daily labour. If everything produced on a day lasts for 10 days then clearly a stock of 10 times what is produced on a day must always be in existence. For all capital in such a state resembles either maturing or depreciating wine.

The depreciating capital can, if we like, be regarded as a number of capitals, linked together, each of which matures into income after a specific period. For example, if a unit of labour is distributed in proportions x_1, x_2 . . . between capitals of periods p_1, p_2 . . . then the stock of x_1 capital will be x_1p_1, of x_2 capital x_2p_2, and so on. In other words, the total stock will be equal to the net production-factor Σxp. If we preferred to define the quantity of capital by reference to the quantity of income, which that capital delivers, we should reach, of course, precisely the same conclusion, that for a given income per day, the quantity of capital is that amount of income multiplied by its "average" period, namely Σip where p is the period of each portion of income i.

If instead of defining the quantity of capital in either of these ways we had defined it by a valuation, would it still be true that the quantity of capital is a function of the period of production? If there is no time-discount, the income-value of labour and of capital (as embodied labour) in the stationary state is simply the productivity of labour, so that the total value of capital is given by the production-factor multiplied by productivity. But if there is time-discount the value of any capital is affected by the period that elapses before it matures into income. In the absence of time-discount every bottle of maturing wine has the same value so that the total value is the total quantity multiplied by a constant (i.e. the productivity of labour, or the ratio of daily wine-income to daily labour in the stationary state). But time-discount causes every bottle to have a different value. If we had a period of production of 10, and therefore a stock of 10 bottles, the value of this stock would be

$(1 + \frac{1}{K} + \frac{1}{K^2} + \ldots \frac{1}{K^9}).C$, where C is productivity and K discount. If we double the period of production, we do not double the value of capital which instead becomes $(1 + \frac{1}{K} + \frac{1}{K^2} + \ldots \frac{1}{K^{19}}).C$. The value of capital is necessarily less than doubled. In other words the quantity of capital, as a value, is not even a function of the production-factor, for any given production-factor may be made up of much time and little labour or much labour and little time; and this will necessarily lead to differences in the value of the resultant stock of capital, provided there is discount. The quantity of capital, as a value, will, however, be a function of the production-factor analysed into the constituent periods of constituent labour, the productivity, and the time-discount.

We now see that if, as is commonly done, the quantity of capital is defined as a quantity of value, different rates of interest resulting from different rates of time-discount in different stationary states or in a non-stationary state from development with or without time-discount, necessarily mean different quantities of capital even though the amount of labour and every period of production were the same in all these cases, and only the rate of interest were different. This only shows that to define the quantity of capital as a value, and then to proceed to investigate the determination of the values and quantities of the various factors of production is to indulge in circular reasoning. The theory of distribution should be an attempt to show how the factors of production come to have relative values. If one of the factors is defined as a value, the theory of distribution becomes merely a statement of compatibilities. If it were not recognized that capital has a time-dimension, then the necessity of defining the quantity of capital as a value would have to be admitted, and Professor Knight's objections

would hold; but unfortunately for Professor Knight, much of economic theory would then become barren. Instead of economic theory being, as we all thought, an investigation into the way relative values come about, it would be found to be merely a consideration of limitations on the movement of some values, when other values happen to change; and this the classical tradition seems sometimes to have recognized. The full fruit of what can be achieved on such lines is to be found in the work of Pigou. But even Pigou becomes at times impatient of these limitations, since he passes beyond what his assumptions appear to permit and reaches conclusions that our analysis must reject when he applies marginal productivity analysis for the purpose of discovering the amount of capital that must exist in a stationary state. He assumes that all the capital (since it is a value) has a value and reaches certain conclusions on this assumption, but he omits to prove that the situation with which he is dealing is compatible with stationariness. Since the fixed capital with which the stationary state is endowed necessarily has a value of zero, whether or not there is time-discount, it follows that any situation in which such capital has a positive value is not stationary. A different kind of impatience with these limitations is shown by Mr. Keynes who seems to ignore them at times and to draw more out of his facts than is permissible. This is managed by shifting the use of the term capital between a value sense and some physical sense in a way which is difficult to follow. For instance, for his purposes he declares that the value of investment is to be taken as the value of the increment of capital, which is not, so it is asserted, to be taken as the increment of value of capital,[1] and yet we look in vain for the definition of capital, which is not a definition by value, that this implies.

As we have already seen, the stationary state may be

[1] Keynes, *Treatise on Money*, vol. i, p. 130.

endowed with capital which it does not produce, i.e. fixed capital which is perpetual or perpetually maintained. Since, without allocating production-periods to the fixed capital itself, we can determine whether or not such fixed capital is maintained in a stationary state (with or without time-discount) we can next proceed to discover the amount of such capital compatible with stationariness. Since the labour of the stationary state is only concerned with maintaining or/and utilizing this capital, it follows that what it adds is not part of this endowment; in which case if the period of either use or maintenance labour is zero, clearly nothing is added to this endowment and if there is delay in receipt of income through this labour having a period, then there is a sense in which it may be said that this endowment is added to. Let maintenance to-day restore the capital for use on the next day, and let this next day's use give fruit in income in two days, e.g. by delivery of a bit of working capital that takes a day to mature. Then the endowment of the stationary state is a stock, x, of capital awaiting maintenance which (if the amounts of use and maintenance labour are equal and the total is 1) increases by $\frac{1}{2}$(the labour of maintenance) and a stock of $2 \cdot \frac{1}{2}$ of working capital; or, if the maturing product is regarded as lying in, or embodied within, the machine, the machine may be regarded as further increased by $2.\frac{1}{2}$. Therefore, the stock of capital is $x + \frac{1}{2}.1 + \frac{1}{2}.2$, or in other words, is always in excess of what is, strictly speaking, inherited from the past by the net production-factor of the labour of the stationary state. Now although the period of use is necessarily the period of production, the period of maintenance may be less than the periods of production of maintenance-labour, according to

the schedule of maintenance-costs and rate of depreciation. Only if depreciation is sufficiently rapid will the period of production of maintenance-labour be the same as the period of maintenance. Therefore, although the period is 1 day in the above example, the period of production is likely to be longer. Instead of $\frac{1}{2}$ for the maintenance increment of capital, the figure may be greater, and x (the capital to be regarded as the strict endowment of the stationary state) will to that extent be less. This, of course, is only to say that that capital which a finite time-discount will allow to depreciate—or, in other words, not allow to come into existence—is not part of the truly inherited endowment of the stationary state, but the product of the labour of the stationary state.

When we pass from the stationary state to the developing state, the relationship between the amount of capital and periods of production is more complex, since the stock of capital is always the product of previous labour, the amounts and periods of which are continuously changing. But we know that the amount of capital is equal to the amount of investment, but only after the period of investment has elapsed. Since the labour of construction of perpetual, or perpetually-maintained, fixed capital has an infinite period, an act of investment in such capital will give an infinite stock only after an infinite time. This, of course, does not happen because all such infinite investments must be followed by infinite disinvestments, i.e. the infinite lengthening of the period of production of labour diverted to the production of such capital is followed by an infinite shortening of the labour subsequently released for shorter methods, such as maintaining and using the capital so produced or for producing other capital. Suppose, for example, labour is diverted from direct production to the production of the whole of the fixed capital required in the stationary state, then the investment is $1 \times \infty$, i.e. the change in the production-

factor being a change from o to $1 \times \infty$. This is followed by maintenance requiring m labour and having, let us say, no period of production. The disinvestment is $m \times \infty$ on account of maintenance and $(1 - m) \times \infty$ on account of labour released for leisure, i.e. the disinvestment is necessarily $1 \times \infty$, for this is the change in the production-factor in the opposite direction from when the investment in fixed capital occurred. From the infinite investment a rate of investment 1 with a period ∞ resulted, while from the infinite disinvestment, a rate of disinvestment 1 with a period ∞ resulted. We can spread the acts of investment and disinvestment as we like, so as to make the excess of the rate of investment over the rate of disinvestment move in any way we like until the last act of disinvestment, i.e. production of the last increment of fixed capital takes place, but as soon as this happens, the rate of investment and the rate of disinvestment necessarily become equal and a stationary state is achieved.

Now it can be shown (as is attempted in the Appendix to this chapter) that there is only one rational way in which such a situation can develop, i.e. a determinate distribution of acts of investment and disinvestment, giving a determinate movement of the net rate of investment, a determinate movement of the rate of interest and a determinate rate of accumulation of capital.[1] And the incrementation of capital

[1] Moreover, we found that investment and saving and the rate of interest all decline in the case of simple and working capital. If there were only one perpetual or perpetually maintained fixed capital method, investment, saving, and rate of interest would increase, as proved in the Appendix to this chapter. This does not, however, affect our general conclusion as to the movement of investment, saving and interest in the real world, owing to the importance of working capital and of the varieties of fixed capital methods for different constituents of income which become profitable at different times in the course of development. Only if a machine having a high cost of construction as compared with its rate of delivery of product were discovered to be of overwhelming importance throughout a large part of industry, could we have a situation in which a community behaving rationally would for a time invest and save at an increasing rate and be subject to a rising rate of interest. A primitive community suddenly adopting capitalistic methods might conceivably,

at any moment will, in the simplest case of a zero period of production, be precisely equal to the net rate of investment at any moment; while, if there is a finite period of construction the rate of incrementation of capital will be given by the net rate of investment of an earlier moment. So long as perpetual or perpetually-maintained capital is being produced at an increasing rate the period of production of the extra labour involved each day is being infinitely lengthened, but as soon as such capital is being produced at a decreasing rate, the period of production of the labour now transferred to maintenance, use, or leisure is being infinitely shortened.

It will now be clear that the period of production is relevant to the rate of incrementation of fixed capital in precisely the same way as in the case of simple capital, namely according to the way in which the replacement of a shorter method by a longer method (with its associated partial replacement of the shorter method by increase of leisure) gives rise to a net rate of investment. It is the period of investment, not the rate of investment, that is affected by the amount of lengthening of the period of production. If a 50-day method replaces a 5-day method, this by itself does not mean a rate of investment different from that which would take place if a 10-day method were adopted; but in the latter case the period of investment is only 5 days in the former, 45. For 5 days as against 45 the incrementation of capital would be the same in either case, but in the former the incrementation would continue for a further 40 days. In the case of maintained fixed capital, a rate of disinvestment necessarily supervenes to check the growth to infinity, which the infinite period of investment would, but for this fact, imply.

find itself in this position. But as soon as the rate of production of the most important kinds of fixed capital ceases to increase, the decline of investment is accelerated, owing to the disinvestment that results from the use of the increasing stock of such capitals.

When simple capital is being built up, the lengthening of production may be regarded as a deterrent and the increase of productivity as an inducement to invest; and the balancing of these considerations determines the net amount of investment and the resultant rates of investment. So also, in the case of maintained fixed capital, the lengthening is the deterrent and the productivity the inducement, revealed not only in the infinite lengthening involved in its construction but also in the infinite shortening involved in its maintenance or use, combined with a productivity consisting simply in the productivity of maintenance or of use.

An important peculiarity of fixed capital development is a kind of explosiveness, which is only to a small extent mitigated by its tendency to act as a brake on itself by its effect on the rate of interest.[1] This brake would be markedly in evidence if fixed capital development happened, at any moment, to be the dominant feature in the whole developmental situation. But this is probably rarely the case; and the effect upon rates of interest of the rapid development that is taking place in one part of the field is completely masked by the general developmental tendency of the rate of interest to fall. It is the non-homogeneous nature of income that makes this explosiveness especially conspicuous, since fixed capital investment in particular directions, which have been completely shut out by a given rate of interest, may become suddenly profitable and be extensively adopted when the rate of interest falls, the slight tendency (consequent on the specific development) of the rate to rise serving only as a weak check on the

[1] It is, perhaps, this noticeable peculiarity of advanced modern communities that has fostered the illusion that investment and saving tend to increase, instead of diminish, as a consequence of the increase of income, considered as a basis for expanding savings. (No doubt they actually do increase; but the main factor at work in producing this result is the continuing expansion of human desires, a force that we have separated out, along with new inventions, as an influence distorting the even flow of development.)

fall. The subsequent disinvestment encourages the fall in the rate of interest; for investment in this particular industry has not been progressively checked by a rising rate of interest (since production in this industry is only a small part of total production), and this industry has therefore reached the completion of a certain structure of fixed capital. Resources are thereby liberated for investment elsewhere, as soon as this structure is complete.

If capital were all of the type we have denoted Simple Capital, or even if it took principally the form of working capital, or simple non-perpetual fixed capital, the rate of interest would show a smooth and gradual decline as development proceeded, and neither mistakes of investment, nor distortions of the value of capital by non-neutral monetary influences, would produce any really grave deviations from equilibrium-development; for, any deviation of the rate of interest from the natural rate (see Chapter IX) would bring into play forces tending to recovery, which might be expected to act quickly. But long-dated fixed capital introduces both a kind of instability in the rate of interest, and an extreme sensitiveness of the economic system to the rate of interest. If the monetary system is unneutral and causes a deviation of the actual from the natural rate, there easily results an explosive production of fixed capital not warranted by the underlying situation. As this is not merely a temporary distortion of the structure of production, such as would appear if the capital were of a simple kind, the whole future is affected and the results of any failure of investment to correspond to the natural rate of interest may well be both catastrophic and cumulative. As we shall see later, the stream of new inventions and wants requires a delicacy of adjustment of the whole economic system which is far greater than is required for equilibrium-development in the absence of such influences, and this adjustment is only achieved if the various rates

of interest move in a very complex manner and the values of the various kinds of capital move correspondingly. If this delicate signal, the rate of interest (or, rather, the whole complex of short-period rates) is disturbed, the consequences, in view of the nature of fixed capital, are bound to take the form of mal-investments of far greater import than would be the case if capital had a simpler nature. As we shall see later, our monetary system is designedly unneutral, owing to the nature of the banking system, and the disturbances in the rate of interest which it produces can be shown to lead inevitably to oscillations of investment that take the form mainly of oscillations of employment. The peculiar nature of fixed capital, which increases the sensitiveness of investment to the rate of interest, and of the rate of interest to investment, turns what might, if capital were comparatively simple, have been merely grave disturbances, into periodic catastrophes.

In the Appendix to this chapter, the equilibrium-development of a community abandoning direct labour in favour of fixed capital is worked out, and a formula obtained for the appropriate movements in the rate of interest and in the values of labour and capital. The more complex formulæ required for lengthy periods of construction, maintenance, and use, and variations in the degree of maintenance, have not been attempted, though the applicability of the method should be clear. Given the determinateness of such development, it is clearly only a matter of more complex calculation to discover the equilibrium-development for any community, whatever the distribution of disutility and utility schedules of its members through time, and however complex may be the schedule of productive methods as regards the use of working and fixed capital. Investment, saving, the incrementation of capital, the increase of income and decrease of labour, the income-value of labour, and the rate of interest, all appear as determinate consequences of the

tendency of members of the community to equate the marginal disutility of labour with the marginal utility of the product ; and deviations from equilibrium-development must be explained by mistakes, or by conditions of the social organization that interfere with this tendency. As we shall see in the following chapters, development tends to be slower than theoretical equilibrium implies, i.e. the rates of investment and saving tend to be unduly low and the rate of interest unduly high, while the monetary system introduces an oscillatory tendency to over- and under-invest and incidentally to produce the phenomenon sometimes described as a difference between the tendencies to invest and to save, a phenomenon which, in the absence of a disturbance of values, would be clearly impossible, unless there were an inherent tendency in human nature to disequate the marginal disutility of labour and the marginal utility of the product, over and above its admitted liability to make mistakes in the normal process of attempting to achieve equi-marginality.

APPENDIX TO CHAPTER IV

We will first take the case of working capital in which labour is applied over a number of days before it matures into income, in order to investigate the way in which working capital is built up as direct labour gives way to this more productive method.

Let the period of production be P, and let W_n be the labour required on the nth day [1] for an income C_P, where C_P is the productivity (i.e. C_P is the income that results from a unit of labour spread over the whole process, and $W_1 + W_2 + \ldots W_P = 1$).

Let x_n be the direct labour of the nth day, and $W_1 y_n$ the indirect labour applied to new capital on the nth day.

Then the md of $(x_n + W_1 y_n + W_2 y_{n-1} + \ldots W_P y_{n-P})$
$= \text{mu of } (x_n + C_P y_{n-P-1})$

And md of $(x_n + W_1 y_n + \ldots W_P y_{n-P})$
$+ \text{md of } (x_{n+1} + W_1 y_{n+1} + \ldots W_P y_{n-P+1})$
$+ \ldots + \text{md of } (x_{n+P} + W_1 y_{n+P} \ldots W_P y_n)$
$= P.C_P \times \text{mu of } (x_{n+P+1} + C_P y_n)$

The truth of the above equation is most readily seen if we regard a unit of working capital maturing into income C_P as the sum of P simple capitals, namely W_1 with period P_1, W_1 labour having been applied on the first day, and W_2 with period $(P - 1)$, and so on. The income into which each of these capitals matures is given by $z_1, z_2, z_3 \ldots$ such that $z_1 + z_2 + \ldots z_P = C_P$. Since $W_1 + W_2 + \ldots W_P = 1$, we can choose $z_1, z_2 \ldots$ so that $W_1 C_P = z_1$, $W_2 C_P = z_2 \ldots$. Therefore, the marginal disutility of labour on the first day is equal to $C_P \times$ the marginal utility of income on the Pth day, and the marginal disutility of labour on the nth day is equal to $C_P \times$ marginal utility of income on the $(P - n)$th day; and, therefore, the sum of the marginal disutilities of labour on each of the P days is equal to $P \times C_P \times$ marginal utility of income on the Pth day. If we make z_n other than $W_n C_P$, we shall, of course, get precisely the same result, provided we accommodate the other z's to maintain their

[1] It is simpler to regard the final income as emerging the day after the final application of labour.

sum equal to C_P, and provided we vary the productivity factor appropriately.

Evaluating y_s and y_{s-1} for the stationary state when x_n has just reached 0 we can solve backwards for successive reductions of n by one integer, until we reach the initial position with $n = 1$.

The stationary state is given by a very much simpler equation, for in the stationary state with interest unity, it makes no difference at what stages in the growth of capital the labour is applied, and the same amount of labour is applied to capital of given maturity on every day, and the sum of the marginal disutilities of y_s labour on each of P days is P times this marginal disutility.

$$\therefore P \times \text{md of } y_s = P.C_P \times \text{mu of } C_P y_s$$
$$\text{i.e. md of } y_s = C_P.\text{mu of } C_P y_s.$$

If Crusoe discounts the future by K, we must introduce the coefficients K^P, $K^{P-1} \ldots K$ as multipliers of the marginal disutilities of labour in the equation which sums these marginal disutilities and the equation for the stationary state will be:

$$\frac{(K^P + K^{P-1} + \ldots K)}{P}. \text{ md of } y_s = C_P \times \text{mu of } C_P y_s$$

if labour is spread evenly and

$$K^P.\text{ md of } w_1.y_s + K^{P-1} \text{ md of } w_2.y_s + \ldots = P.C_P \times \text{mu of } C_P.y_s$$

if a unit of labour is spread in proportion $w_1, w_2 \ldots$

Similar equations can be constructed for Crusoe's development through the next period of development, and no difficulty arises in the conception of an equilibrium through time, however impossible Crusoe's task of calculating it. Development for a community is, in some respects, less prone to mistakes than it is for Crusoe, for if labour is applied unevenly to capital, Crusoe may commit himself to too much or too little labour on some future date, but in a community, if A has produced too much capital in view of the labour required for it on some future date, there is likely to be a B who has produced too little, so that exchange will rectify the mistake.

There is one important respect in which development will differ under working capital from development under simple capital: i.e. that under the latter the period of production necessarily

lengthens as development proceeds, but under working capital this is not so ; in fact a shorter method may be more productive than a longer, if in the former most of the labour is applied towards the beginning, while in the latter it is applied towards the end of the period. Therefore, development will proceed not only by the lengthening of the period of production, but by the substitution of methods with more labour in the early stages than in the later. This does not mean that we can ever pass to a shorter period of production, but it does mean that at the beginning of each period of development there will tend to be a temporary resort not only to methods of periods lying between that of the method which is just being abandoned and that which is being adopted but even to several methods of the same period of production.

We have already seen that in the case of simple capital, when methods P and P′ are in competition, so that the average (geometrical) rate of interest per day is $\left(\frac{C_{P'}}{C_P}\right)^{\frac{1}{P'-P}}$, then the next most productive method P″ is given by the maximum value of $\left(\frac{C_{P''}}{C_{P'}}\right)^{\frac{1}{P''-P'}}$ for longer methods P″. In other words it is given by that method which brings about the least fall in the rate of interest P′ days hence. To discover the series of most productive methods, or the series of methods which give the least fall in the rate of interest, in the case of working capital is more difficult. One method of approach is as follows.

So long as Crusoe is engaged in direct production, we can assign the income resulting from each day's labour, by equivalent methods of simple capital production, to each day's labour, and we can reduce any method of production of period P to the repetition of a method of period 1 (see Chapter III). Let x be the equivalent productivity per day (i.e. x income matures the next day from 1 unit of labour), then if P is the period of production and C_P the productivity, and $w_1, w_2 \ldots w_P$ the labour of each day (and $w_1 + w_2 + \ldots w_P = 1$ labour and gives C_P income), x is given by :—

$$w_1x^P + w_2x^{P-1} + \ldots w_Px = C_P$$

That method which makes x a maximum (we may neglect the remote possibility of there being several) will necessarily be

adopted at the outset, and all methods that are shorter in descending order of productivity. Since x can be greater, even when we make C_P and P less, by increasing w_1, w_2 . . ., at the expense of w_P, w_{P-1} . . ., this increases the number of methods which may be temporarily adopted at the outset.

When we pass from method P to the next most productive method P′ with labour-application w'_1, w'_2 . . . $w'_{P'}$ then from the Pth to the P′th day we have a productivity y so that

$$w'_1 (x^P + y^{P'-P}) + w'_2 (x^{P-1} + y^{P'-P}) + \ldots$$
$$\ldots w'_P (x + x^{P'-P}) + w'_{P+1} y^{P'-P} + \ldots$$
$$\ldots w'_{P'} y = C_{P'}$$

Whatever method makes y a maximum is the method which progressively replaces the previous method of period P, though there will, of course, again be a temporary resort to methods lying between P and P′.

x is, of course, the rate of interest (or rather the geometric mean of the rates which rise over each period of production) for the first period of development, and y is the rate of interest (or, more accurately, the geometric mean of the rates) for the next period of development.

If we assume, for illustration, that working capital grows by even applications of labour, we obtain a comparatively simple formula for the rate of interest, for x is now given by

$$\frac{1}{P} (x^P + \ldots x) = C_P$$

$$x^P + \ldots + x = P.C_P$$

and y is given by

$$\frac{1}{P'} (x^P + y^{P'-P}) + \frac{1}{P'} (x^{P-1} + y^{P'-P}) + \ldots$$

$$\ldots + \frac{1}{P'} y^{P'-P} + \ldots \frac{1}{P'} y = C_{P'}$$

$$\therefore x^P + \ldots x + (P+1)\, y^{P'-P} + y^{P'-P-1} \ldots + y = P'.C_{P'}$$
$$\therefore (P+1)\, y^{P'-P} + y^{P'-P-1} + \ldots + y = P'.C_P - P.C_P$$

It would not be profitable to investigate further the quantities and values of the various kinds of working capital which develop in a community on our assumption, but we may note that, as in the case of simple capital, the rate of interest will trend downwards, though it will tend to move upwards in each period

of production and fall at the end, while preserving an average (geometrical) rate of interest throughout a period of development, and the fall to a new rate of interest will always be a period of production later than the change in the allocation of labour to the new method of production, which is the reason for the fall. As in the case of simple capital, the income-value of labour and of all kinds of capital will rise over the period anterior to the fall in interest and then remain stationary over the period of development. The intermediate period over which the rate of interest is falling may be of any length, depending upon the relative schedules of utility and disutility, or, what comes to much the same thing, the distribution of wealth in the community.

We have still to deal with fixed capital, the peculiarity of which is that income matures over a number of days from previously applied labour.

Consider first a simple kind of fixed capital in which 1 unit of labour to-day gives a total of C income (or $\frac{C}{L}$ on each of the next L days).

On any nth day if x_n is direct labour and y_n indirect, then

$$\text{md of } (x_n + y_n) = \text{mu of } (x_n + \tfrac{C}{L}y_{n-1} + \tfrac{C}{L}y_{n-2} \cdots + \tfrac{C}{L}y_{n-L})$$

$$= \tfrac{C}{L} \times \text{mu of } (x_{n+1} + \tfrac{C}{L}y_n + \tfrac{C}{L}y_{n-1} + \cdots \tfrac{C}{L}y_{n-L+1})$$

$$+ \tfrac{C}{L} \times \text{mu of } (x_{n+2} + \tfrac{C}{L}y_{n+1} + \cdots)$$

$$+ \cdots + \tfrac{C}{L} \times \text{mu of } (x_{n+L} + \tfrac{C}{L}y_{n+L-1} \cdots \ ),$$

and in the stationary state

$$\text{md of } y_s = L.\tfrac{C}{L} \times \text{mu of } (\tfrac{C}{L}.Ly_s) = C \times \text{mu of } Cy_s;$$

but if there is discount K

$$= \tfrac{1}{K}.\tfrac{C}{L} \times \text{mu of } Cy_s$$

$$+ \frac{1}{K^2} \cdot \frac{C}{L} \times \text{mu of } Cy_s$$
$$+ \ldots$$
$$= \left(\frac{1}{K} + \frac{1}{K^2} + \ldots \frac{1}{K^L}\right) \cdot \frac{C}{L} \times \text{mu of } Cy_s$$

If the amounts of income accruing each day are different, e.g. if they fall gradually to zero, the equations will be unchanged, but for the substitution of $\frac{C}{L_1}, \frac{C}{L_2} \ldots$ (where $\frac{C}{L_1} + \frac{C}{L_2} + \ldots = C$) for the productivity $\frac{C}{L}$ in the above equation.

Since the value of income on any day is equal to the value of $\frac{C}{L}$ income the next day + the value of $\frac{C}{L}$ income the day after $+ \ldots +$ the value of $\frac{C}{L}$ income on the Lth day, then, if x is the rate of interest :—

$$x^L = \frac{C}{L} (x^L \times x^{L-1} + \ldots x).$$

Alternative expressions would be :—

$$\frac{x^L + x^{L-1} + \ldots x}{x^L} = \frac{L}{C} \quad \text{or} \quad 1 + \frac{1}{x} + \ldots \frac{1}{x^{L-1}} = \frac{L}{C}$$

$$\text{or} \quad \frac{x^{L-1} - 1}{x - 1} = \frac{L}{C}.$$

If, instead of labour on one day we have labour applied on a number of days to the production of income on a number of days, the equations will be complicated to the extent of requiring a sum of marginal disutilities on the left-hand side on the principle already given for working capital (p. 107).

From these equations, we can work backwards from the stationary state and determine the values of x and y, as n moves from s to 1—and, adopting the same method, we can determine the process by which one use of fixed capital progressively displaces another (with the rate of interest falling), or, of course, displaces or gives way to the use of working capital. It would not be profitable to attempt the construction of the equations which show this process in detail, since no new principle is

involved and fixed capital of this kind may be regarded merely as a more complex form of working capital.

While a great deal of fixed capital may be looked at in this way, the outstanding characteristic of certain kinds of fixed capital lies in the fact that a product can be perpetually produced provided labour continues to be applied. It is, in fact, theoretically possible for fixed capital to produce income perpetually without the application of labour.

If fixed capital producing a perpetual income without the perpetual application of labour were possible, then in the stationary state there will be no labour and an income having a marginal utility just zero. If C is the daily income from a unit of labour applied to producing such fixed capital, then in the stationary state :—

$$\begin{aligned} &\text{md of } y_s \\ &\quad = C \times \text{mu of } C\,(y_{s-1} + y_{s-2} + \cdots y_1) \\ &\quad = 0 \end{aligned}$$

where $y_1, y_2 \cdots y_{s-1}$ is the labour applied to producing fixed capital on each day of the period of development, the sum of which we will call Y.

We have first, the following set of equations

$$\begin{aligned} &\text{md of } (y_{s-1}) \\ &\quad = \Sigma(C \times \text{mu of } Cy_s) \\ &\quad = 0 \end{aligned}$$

where Σ refers to the sum of stationary states.

In other words, the stationary state is approached asymptotically, since y_{s-1} must be made to approach 0, but if we assume that the stationary state is achieved the day after the last indivisible unit of labour is applied, then we have y_{s-1}, and we can proceed to the next equation

$$\begin{aligned} &\text{md of } (y_{s-2}) \\ &\quad = C \times \text{mu of } C\,(Y - y_{s-1}) \\ &\qquad + \Sigma(C \times \text{mu of } CY). \end{aligned}$$

The latter term we can neglect as it equals 0 and so y_{s-2} is evaluated, if there is no direct labour.

And our third equation is

$$\begin{aligned} &\text{md of } (y_{s-3}) \\ &\quad = C \times \text{mu of } C\,(Y - y_{s-1}) \\ &\qquad + C \times \text{mu of } C\,(Y - y_{s-2}) \end{aligned}$$

and y_{s-3} is evaluated, if there is no direct labour.

And our nth equation from the stationary state, assuming no direct labour :—

$$\begin{aligned}\text{md of } y_{s-n} &= C \times \text{mu of } C(Y - y_{s-1}) \\ &\quad + C \times \text{mu of } C(Y - y_{s-1} - y_{s-2}) \\ &\quad + C \times \text{mu of } C(Y - y_{s-1} - y_{s-2} \cdots - y_{s-n+1})\end{aligned}$$

and y_{s-1} to y_{s-n} have been evaluated.

If C is greater than 1, the latest term at which direct labour x can just cease is the last before the stationary state,[1] so we have

$$\begin{aligned}&\text{md of } (0 + y_{s-1}) = 0 \\ &\quad = \text{mu of } (0 + C[Y - y_{s-1}]) \\ &\quad \text{which evaluates } y_{s-1}, \\ &\text{md of } (x_{s-2} + y_{s-2}) = C \times \text{mu of } (0 + C[Y - y_{s-1}]) \\ &\quad = \text{mu of } (x_{s-2} + C[Y - y_{s-1} - y_{s-2}]) \\ &\quad \text{which evaluates } x_{s-2} \text{ and } y_{s-2} \text{ and} \\ &\text{md of } (x_{s-3} + y_{s-3}) \\ &\quad = C \times \text{md of } (0 + C[Y - y_{s-1}]) \\ &\qquad + C \times \text{md of } (x_{s-2} + C[Y - y_{s-1} - y_{s-2}]) \\ &\quad = \text{md of } (x_{s-3} + C[Y - y_{s-1} - y_{s-2} - y_{s-3}]) \\ &\quad \text{which evaluates } x_{s-3} \text{ and } y_{s-3}.\end{aligned}$$

Continuing with these equations, we eventually reach x_1 and y_1. The whole course of equilibrium-development is thus precisely determined.

If C is < 1, the latest term at which direct labour can just cease is that for which

$$\begin{aligned}\text{md of } y_{s-n} &= C \times \text{mu of } C(Y - y_{s-1}) \\ &\quad + C \times \text{mu of } C(Y - y_{s-1} - y_{s-2}) \\ &\quad + \ldots\ldots \\ &\quad + C \times \text{mu of } C(Y - \ldots y_{s-n+1}) \\ &= \text{mu of } C(Y - \ldots y_{s-n})\end{aligned}$$

for the smallest value of the integer n.

The necessity for x to vanish as near the stationary state as possible is given by the consideration we have already referred to in connection with working capital, that if only one capitalistic method is developing, any rate of development less than the maximum rate is necessarily a loss of utility through time, just as, when one method is replacing another, utility through

[1] i.e. when y_{s-1} is as small as it is possible to make it, and for convenience of exposition we make this a conveniently small finite amount.

time is maximized by adopting the maximum rate of displacement.

In the next pair of equations we have the first occurrence of a value for x, namely, x_{s-n-1} and y_{s-n-1}, which are evaluated by these equations. Continuing, we can evaluate x_n, y_n, until $n = 1$, the first day of development, the equilibrium course of which is again quite determinate.

If Crusoe discounts the future by K the course of development is slowed down, for $\frac{1}{K}$ must be introduced as a multiplier of C, which multiplies the marginal utilities in the above equations.

The stationary state is, of course, the same whether or not there is discount, and the total value of capital is 0 in either case.

The value of income n days before the stationary state is equal to the value of C income the next day + C income 2 days hence + . . . + 0, the value of C income every day of the stationary state. And the value of C income $(n - 1)$ days before the stationary state is equal to the value of C^2 income the next day + C^2 income 2 days later + . . . + 0. And the value of C^m income $(n - m)$ days before the stationary state is equal to the value of C^m income the next day + . . . + 0.

Therefore, the value of income n days before the stationary state is equal to the value of $0 + C + C^2 + C^3 + \ldots C^{n-1}$ income the day before the stationary state, and the value of income $(n - 1)$ days before the stationary state is equal to the value of $0 + C + C^2 + \ldots C^{n-2}$ income the day before the stationary state. And therefore the value of income n days before the stationary state is equal to the value of

$$\frac{0 + C + C^2 + \ldots\ldots C^{n-1}}{0 + C + \ldots\ldots C^{n-2}}$$

income the next day; in other words the rate of interest on the nth day is given by this expression.

If $n = 1$, then the rate of interest is $\frac{C}{0}$, for if we make the income of the day before the stationary state finitely less than that of the stationary state, then only an infinite amount of the next day's valueless income could have a value equal to a unit of the previous day's income.

As n is increased the rate of interest falls from $(1 + C)$ to

$C + \frac{C}{C + \ldots C^{n-2}}$, for the above expression for the rate of interest may be written :—

$$\frac{C\,(C + C^2 + \ldots + C^{n-2}) + C}{(C + C^2 + \ldots c^{n-2})}$$

$$= C + \frac{1}{1 + C + \ldots C^{n-3}} = C + \frac{1 - C}{1 - C^{n-3}}$$

Therefore, if $C > 1$, the rate of interest falls towards C as a limit, looking back from the stationary state.

But if $C < 1$, the rate of interest falls towards 1 as a limit, looking back from the stationary state.

The number of days required for development to a state approximating to, but of finitely less income than that of the stationary state, is given by our development equations, and therefore the rate of interest on the first and all subsequent days. The rate of interest rises from a figure > 1 if $C < 1$, or from a figure $> C$, if $C > 1$, at an increasing rate until it reaches the figure $C + 1$, when direct labour is abandoned and the state is about to become approximately stationary.

Equations can readily be constructed to meet the more complex cases of capital requiring a number of days to mature and a number of days' application of labour, and there is no difficulty in making the extension from Crusoe to an exchange-community, but as these points will be dealt with in connection with fixed capital which gives a perpetual income by the perpetual application of labour, we will not consider this rare type of fixed capital further. It will also become clear in what way development is modified, if, instead of only two methods of production, direct labour and fixed capital giving a perpetual income, we have a host of other working capital and fixed capital methods, for, as we shall see later, the most economical development will require the temporary use of a number of these methods alongside direct labour and the fixed capital method which finally ousts all others.

We will now pass to the more realistic case of fixed capital, giving a perpetual income from the perpetual application of labour.[1] Let F units of labour be required to produce that

[1] It is this kind of fixed capital that we refer to when we use the term without qualification.

quantity of fixed capital which requires the application of a unit of labour on the next and every subsequent day and produces C units of income on the second and every subsequent day.

The stationary state is given by the equation :—

$$\text{md of } y_s = C \times \text{mu of } Cy_s.$$

On the day preceding the stationary state, labour is applied to the last addition of fixed capital made the preceding day, and is, therefore, y_s. Let z_{s-1} be the amount of this labour applied to the last increment of fixed capital, then the income of the day before the stationary state is $C(y_s - z_{s-1})$.

The day previous to this, the last increment of fixed capital has been produced by means of Fz_{s-1} labour, while $(y_s - z_{s-1})$ labour is applied to the use of fixed capital. Since $\frac{C}{F}$ is bound to be < 1 in any likely case, direct labour will have been abandoned some days before the stationary state is achieved (see p. 114).

Call Y_s, given by the equation for the stationary state, Y. Then we have [1] :—

$$F \times \text{md of } (Y + Fz_{s-1} - z_{s-1}) + \Sigma (\text{md of } Y)$$
$$= C \times \text{mu of } CY + \Sigma (C \times \text{mu of } CY)$$

where Σ (md of Y) is the sum of as many terms of the stationary state as Σ(C × mu of CY) and of as many terms as we like to take ; so that Σ(md of Y) equals Σ(C × mu of CY) and therefore need not be entered in the equations.

This equation is only satisfied by making z_{s-1} approach 0, so that again we have an asymptotic approach to the stationary state, which is never in a finite time completely attained. Let us make z_{s-1} an indivisible and finite unit, then our next equation, proceeding one day further back is :—

$$F \times \text{md of } (Y + Fz_{s-2} - z_{s-1} - z_{s-2})$$
$$+ \text{md of } (Y + Fz_{s-1} - z_{s-1})$$
$$= C \times \text{mu of } C (Y - z_{s-1}) + C \times \text{mu of } CY$$

which again requires z_{s-2} to be as small as possible.

Continuing with these equations, we shall eventually come to an equation which can be solved only by making z_{s-n} greater than z_{s-n+1}, and therefore Fz_{s-n} greater than Fz_{s-n+1}. The day on which Fz falls to its minimum is the day on which

[1] For F units of labour on the first day and 1 unit on each subsequent day produce C units of income on the third and each subsequent day.

x, direct labour, just vanishes, in order to preserve the condition of maximum rate of development (see p. 114).

We have therefore the following equations :—

$$\begin{aligned} F \times \text{md of } (0 + Y + Fz_{s-n} - z_{s-1} - z_{s-2} \ldots - z_{s-n}) \\ + \text{md of } (Y + Fz_{s-n+1} - z_{s-1} - \ldots - z_{s-n+1}) \\ + \ldots + \text{md of } (Y + Fz_{s-1} - z_{s-1}) \\ = C \times \text{mu of } C\,(Y - z_{s-1} - \ldots z_{s-n+1}) \\ + C \times \text{mu of } C\,(Y - z_{s-1} \ldots - z_{s-n+2}) \\ + \ldots + C \times \text{mu of } CY \\ = \text{mu of } (0 + C\,[Y - z_{s-1} - \ldots z_{s-n-1}]) \end{aligned}$$

giving us z_{s-n} and z_{s-n-1}.

The next pair of equations give us x_{s-n-1} and z_{s-n-2}, and continuing in this way, we eventually reach x_1 and z_1 (when $z_{s-1} + z_{s-2} + \ldots + z_1 = Y$).

The whole course of development is thus precisely determined, and, if we assume that z_{s-1} can be made as small as we please, the course of development to a point as near as we please to the stationary state.

Since on any day the value of a unit of labour is 1 income on that day, then, if, for simplification, we regard the income from capital as accruing on the day labour is applied, then $(C - 1)$ is the income obtained from F labour the previous day.[1]

Therefore, the value of income on any day is the value of $\frac{C-1}{F}$ income the next day + value of $\frac{C-1}{F}$ income the following day + ... + 0 for every day of the stationary state where the value of a unit of labour has become C, so that $\frac{C-C}{F} = 0$.

Therefore (as proved on p. 115 for perpetual income capital), the rate of interest n days backwards from the day on which direct labour is abandoned, is given by :—

$$\frac{C-1}{F} + \frac{1 - \frac{C-1}{F}}{1 - \left(\frac{C-1}{F}\right)^{n-3}}$$

If $n = 1$, then the rate of interest is $\frac{C-1}{F} + 1$, and since

[1] The formula is rather more complex, if we assume that labour applied to capital gives income on a later day.

$\frac{C-1}{F}$ is < 1, falls at a diminishing rate back to the first day.

Therefore, on the first day the rate of interest is given by means of n, which can be obtained from the development-equations. The rate rises at an increasing rate to the maximum $\frac{C-1}{F} + 1$. The income-value of labour and new capital will remain unity throughout, but day-old and, therefore, n-day-old capital, will fall in income-value over this period until direct labour is abandoned and labour rises in value to C and capital rises in value to FC. But if we assume that the stationary state, not an approximate stationary state, is achieved, a further increment of fixed capital has no value, so that the value of capital becomes zero instead of FC, and the total income-value of capital which was YFC (Y being the daily labour of the stationary state) in the approximate stationary state, becomes zero, and the quantity of capital YF.

If Crusoe discounts the future by K, the stationary state will be identical with that achieved in the absence of time-discount, in the extreme case of income maturing on the day labour is applied to fixed capital and on the assumption that there is no cost of maintenance, and again the quantity of fixed capital will be YF, and its value zero, as also is the case in the absence of time-discount.

If, however, income accrues on a later day than that on which the labour is applied, or the capital can be allowed to deteriorate while still producing income, though a diminishing one, from the application of labour, time-discount, K, modifies the situation and the stationary state is given by :—

$$\text{md of } Y = \frac{1}{K^p} \cdot C \times \text{mu of } CY$$

where p is the period which elapses between the application of labour and the income from it ; and the equilibrium amount of fixed capital may be even less, according to the way in which it deteriorates in the absence of maintenance.[1]

Although on the assumption of effective time-discount the stationary state will be identical with, or very little different,

[1] These conclusions run counter to those of Professor Pigou in the *Economics of Stationary States*, chapter x, for Professor Pigou is adopting the orthodox view of fixed capital which assumes that it is not *merely* delayed income.

if there are periods of use or maintenance, from that achieved in the absence of discount, the rate of development will be very much less, even with a very low discount.

Obviously, we do not need to assume that fixed capital is produced on one day and that it is ready for the production of income on the next. However many days are required and however unevenly the labour is spread, we can construct our development equations by complicating the equations in the way indicated for working capital. And no new principles are involved in passing to an exchange-community, except that whereas in the case of working capital only a part of the early capital bought by those who are the first to abandon direct labour is re-sold before the rate of interest drops to zero (or to the new lower level), the whole of the fixed capital which is bought cheap by those who first abandon direct labour is re-sold as the rate of interest falls. It may further be pointed out that income may accrue from fixed capital by the application of labour over a number of days—in other words, what is delivered each day by the fixed capital is a piece of working capital or even another piece of fixed capital. This raises no difficulty of principle, though the task of constructing appropriate equations becomes correspondingly more difficult.

Another peculiarity of fixed capital development lies in the fact that there is only one period of development, for the most productive method, in the sense of maximum C, whatever F may be, will be adopted from the outset, and as soon as the stationary state is achieved, no further development can take place. In a world of new inventions this is a point of great importance, virtually transforming all fixed capital (except that which gives a perpetual income without labour) into our first type, in which there is a finite period over which income is obtained from the application of labour ; for if a new invention introduces a fixed capital method, for which C is greater than for that method which is being developed, then there is a finite time within which all the early fixed capital becomes worthless and a finite period within a finite time over which the amount employed diminishes from full employment to zero employment, or, owing to exchange, in which it is more or less fully employed while the quasi-rent falls gradually to zero or, in other words, its value falls gradually to zero. We may put it in this way, that there is a certain general obsolescence risk-factor, which, if

evaluated, would give us the equivalent fixed capital with a finite series of labour applications and income receipts. We shall have to return to this point when we drop the assumption of a given schedule of productive methods.

We found, in the case of working capital, that, although by the end of one production-period after resort to a new method has commenced, only two methods will be in simultaneous use, there may be any number of shorter methods in simultaneous use at the beginning, these being successively abandoned while the rate of interest rises as shorter less productive methods are abandoned in favour of longer. In the case of fixed capital, productivity is C only from the point of view of an infinite period—there is no finite period of production (for fixed capital with perpetual income), but there is an increasing productivity from the point of view of any period longer than that in which income first matures after labour begins to be devoted to producing the capital. For any finite period R, the productivity of fixed capital is given by

$$\frac{\frac{C(R-2)}{F}}{1+\frac{R-1}{F}} \quad \text{or} \quad \frac{C(R-2)}{F+R-1}$$

(where 1 labour produces fixed capital the next day which requires the application of $\frac{1}{F}$ labour on every day after the first and gives $\frac{C}{F}$ income on every day after the second). If the most productive working-capital method when Crusoe is performing direct labour has a period P, and for this period P the productivity of fixed capital is less than C_P (the productivity of working capital), then there will from the outset be some resort to this working-capital method, and to all those shorter methods that are consistent with it (in the way already investigated in Chapter III), provided the fixed capital stationary state is not yet attained. It would obviously be possible to construct the equations which exhibit this modification of development on the lines we adopted in Chapter III. It is also possible for a fixed capital method with a smaller C, but a very much smaller F or shorter period over which F is spread, to be temporarily adopted. Since the whole of this fixed capital will eventually become

valueless, any such capital may be regarded as fixed capital with a definite number of labour-applications and income-receipts.

Our general conclusions as to the growth of capital and income, assuming that capital may take any form, may now be summarized. The general trend of the rate of interest is downwards, in so far as longer and longer methods of production by working capital or simple fixed capital successively replace one another, but within each period of production the rate of interest moves upwards dropping at the end of each period, a movement which becomes smoothed out as the period of production lengthens. In so far as there is a fixed-capital method more productive than these other methods, it will from the beginning be adopted but only to a negligible extent, but as the rate of interest falls, its competition with other methods becomes appreciable, and the fall in the rate of interest will be checked and the rate of interest may even rise in the last period when only one other method of production is left to compete with it and is being abandoned. The general downward trend of the rate of interest will also have been mitigated by the temporary adoption of less productive fixed-capital methods of shorter periods or larger values of $\frac{C}{F}$. Economical development may well require the construction of fixed capital, intended ultimately to be thrown away, and equilibrium can occur with the simultaneous production of several kinds of fixed capital, provided the rate of production of a more productive is greater than that of a less productive method.

When we try to interpret interest, the following points must be borne in mind. Whenever we commit resources to a method of production, we do so because we compare the fruit with alternative fruit. If the alternative use of resources gives fruit sooner, we are comparing two futures—we are not comparing the future with the present. In a developed community, we never except in very rare cases compare using resources which give an income in, say, 2 years with using those resources to give an income now. At the outset of development we do, of course, have to make a very complex choice, for we are allocating resources so as to give appropriate fruit on a whole series of future occasions, which may extend to an infinite future, if we

are aware of a fixed capital method, which is more productive than all others. Therefore, at the commencement of development we are establishing income-value ratios over a vast future, and there is no contradiction in the fact that the existence of more alternatives lowers the immediate rate of interest, for, at the same time, it raises future rates, and, therefore, leads us to work harder, not less hard, than we otherwise should, and do with less, not more, income. The rate of interest is low over a short period in order that it can be higher than would otherwise be the case over a long period. Again, if there were only one more productive method, the rate of interest would be high over a development-period only to become zero beyond it. Suppose we introduce a longer more productive method, then interest would fall but remain above zero.

In fact, the greater the diversity of possible methods, once a community has developed beyond the use of direct labour, the more likely is the rate of interest to be low and the less likely is it to fall at an appreciable rate even without new inventions. But as soon as this phase of low interest has been reached, and it is, of course, the phase which has been reached by all modern capitalist societies, it is a very remote future interest which is, in effect, relevant whenever decisions are made to commit resources in any way.

The point of the above argument may be seen by contemplating, once again, the meaning and significance of saving. At the outset of development, a community saves the whole of that income, which would result if its labour were applied directly, and not as a matter of fact devoted to capital. From this capital income matures at a number of future dates, which, if the capital is simple, requires no more saving. If later the community, receiving the income from this capital, produces as much capital as disappears by maturing into income, the community is not saving, it is receiving in income precisely the value of its labour, and if it did behave in this way would be in a stationary state with no interest (unless there is effective time-discount). But if the community applies some of its labour to longer methods of production, it alters income which would appear at one future, to a larger income at a later future and therefore it saves a future income. Saving, in a developed community is, therefore, always a future activity arranged in the present—a sacrifice of

future income for income at a more remote future, the price being the rate of interest between those two future dates, regardless of what the rate is now. And there is no such thing as a supply of saving now and no such thing as a demand for saving now and there is no equilibrium of these two now which gives us the rate of interest now.

Chapter V

INHERITANCE: LAND

Neither Crusoe nor the members of a community are immortal, and a super-sapient Crusoe will, therefore, not develop in the way we have assumed. If Crusoe has a given expectation of life, there is no difficulty in constructing suitable equations for a development that then becomes very much simpler, since all kinds of working-capital methods having more than a certain period, as well as fixed-capital methods with too long a period of construction or too small a ratio of income to labour of construction, will not be considered in his calculations. But a community is immortal; and since any kind of capital can be sold at any time, no one needs to consider whether the capital he constructs will yield its income in a lifetime, and therefore development is not affected by this consideration. A person may, however, wish to enjoy the fruits of his labour during his lifetime. If this attitude were universal, development would be slowed down considerably; for on the assumption of an unchanging attitude to work and income throughout the future, everyone might be expected to labour from the beginning in such a way as to provide himself with present income and an annuity for the rest of his life, additional annuities being purchased on successive days on each of which the amount of labour diminishes. Development on this assumption could be readily discovered; but, as a matter of fact, behaviour seems to be more consistent with the assumption of immortality, and in practice lies somewhere between these two extremes and nearer what we should expect on the latter assumption—in fact, to die

wealthy seems more satisfactory for most people than to die poor, and there are many who would arrange to be wealthier at any given age, if they expected to die at that age, than they would find themselves to be at that age if they expected to live to a much later date. It seems that not much error is introduced if we assume that wealth is accumulated as if everyone acted on the assumption of immortality.

People do, however, die, and their wealth does not successively pass into the hands of single inheritors having the same attitudes to labour and income as the testators, even in a community with a stationary population. In fact, the greater any particular inheritance, the greater the chance that the inheritor will have an attitude to labour and consumption that causes him on balance to disinvest, through his income becoming greater than the total income-value of the labour he now expends, while but for inheritance, the income-value of current labour must be greater than current consumption, if behaviour on the whole approximates to what it would be if a person considered himself immortal. Development will, therefore, to this extent be slowed down. Smaller fortunes, bequeathed to a number of persons, may conceivably, of course, produce the opposite effect, the sum of changes in income and labour of the inheritors being negligible. This does not, however, modify the conclusion that the net effect of inheritance is to transfer wealth from the more wealthy to the less wealthy and, therefore, from more accumulating types to less accumulating types, so that development tends to be slowed down. If there were no selection of inheritors by testators, the situation resulting from inheritance would be equivalent to a haphazard redistribution every day of a fraction of the community's wealth equal (on the assumption of a stationary population) to the ratio of deaths per day to the number of the whole population.

If wealth always passed to persons who had not yet

accumulated any wealth, and who had exactly the same utility and disutility schedules as the testator, we should have the situation envisaged in our equations. Inheritance would then involve no " exploitation " [1] of one set of persons by another, for the behaviour of each would (as far as the present problem is concerned) be of benefit to every other, whatever the rate of interest. Those who accumulated wealth more rapidly would increase the incomes of those who were less active, and if we were to speak of exploitation at all, we should have to say that the poor exploited the rich ; for, since the poor would be those who would be content with less work and less income, both rich and poor would be less wealthy than they might be. In such a world, interest would not be a surplus created by labour and passing into the possession of others ; and this consideration alone is sufficient to refute any theory of interest that regards interest in its entirety as such a surplus.[2] But as soon as we take into account (ignoring, however, certain obvious psychological effects) the way in which the system of inheritance actually works, we seem to find in it a predominatingly decumulative bias. Wealth does not, in the main, pass from the rich to those whose utility and disutility schedules bias them in favour of becoming richer—it tends to pass to those who would be likely to disinvest by exchanging capital for income, and thus the income-value of their labour-output is less (for the time being)

[1] In the sense of producing an adverse effect on the income-value of labour of other members of the community.

[2] Suppose the majority of wage-earners own no capital and spend the whole of their wages, and those who own the community's capital spend the whole of their receipts from their own labour and cease to save, then real wages become stationary, instead of rising ; there is no further abandonment of shorter methods of production in favour of longer more productive methods ; the rate of interest falls to unity (0%) ; and, with the structure of production ceasing to change, a stationary state is achieved. But the fall in interest brings no benefit to labour. On the other hand, if the minority continue to save and thus maintain a rate of interest, wages must rise. Interest is thus to be regarded as a surplus that adds to wages rather than a surplus (as seems to be implied in the Marxian theory of interest, taken in its superficial sense) that is deducted from wages.

than their consumption. We have now a kind of exploitation ; for the behaviour of those who are decumulating is a disadvantage to others, and the higher the rate of interest the greater is their power to exploit the rest of the community. But that interest gives the power of exploitation and that inheritance leads to the exercise of this power cannot by themselves warrant the conclusion that interest is a surplus created by labour and undesirably abstracted by other members of the community. Also it should be noticed that the exercise of this power while in itself tending to lower the rate of interest (since this is an expression of the lowered valuation of future income in terms of present income), tends at the same time to decrease the rate at which interest falls throughout the future (owing to the way in which it checks the growth of capital and slows down development).

Since the significance of inheritance differs from community to community, owing to differences in their social organisation, it is necessary in each case to modify our conception of equilibrium-development if we wish to allow for its influence, since it is a factor producing results that can be more or less foreseen in each case, and, therefore, affects everyone's decisions with regard to his own labour-output and his own distribution of income through time. A community that accepts the principle of continued individual ownership of wealth by means of inheritance will then be one in which equilibrium-development is slower than in a community that restricts in any way the influence of inheritance (e.g. by taxation or collective ownership), provided the labour-income schedules of the members are not in any way affected by this interference. A communist society might, therefore, be expected to have a greater rate of development than an individualist society, and to be marked by a rate of interest which, though higher in the early stages, would be falling at a greater rate.

We have, so far, proceeded on the assumption that wealth is the product of labour and no other scarce factor. But wealth exists in the form of land with which labour must co-operate in the production of income. It is convenient to regard land as a fixed stock, and in so far as this is true there is no need to give it separate consideration in the building up of our equations of development; for if development is determinate on the assumption of elastically supplied labour, the existence of a determinate stock of wealth from the beginning affects development in a way which offers no difficulties of treatment. It should be noticed that the wealth represented by the stock of land is almost entirely of the nature of fixed capital yielding perpetual income by the perpetual application of labour, though the case of land from which non-replaceable constituent minerals are removed deserves special mention for a theory of development with its implication of a goal—the stationary state—which could not be achieved so long as any such constituent minerals remained, while development could never permit of the stock being completely denuded.

If, for the moment, we neglect the fact that a piece of land does not produce a given amount of generalized income but only particular constituents of income, its value is given by precisely those considerations which determine the value of produced fixed capital at any moment. If we know the rate of interest and the value of labour throughout the future, we know the present income-value of that piece of land, as of any other piece of capital. But in the case of produced capital it does not derive its present value from future values of labour and rates of interest, but in equilibrium is produced in definite amounts as a result of those individual decisions which also lead to those future values of labour and rates of interest that may be said to provide the capital with its value. Since the wealth represented by land is associated with a host of longer and longer

methods of production involving its use, future rates of interest are as much a consequence of its amount and nature as of the amount and nature of labour, the scarcity of which necessitates gradual development instead of immediate arrival at a stationary state. If land is individually owned and rises in value in the course of development the associated windfall gains to individual owners may be expected to produce effects on development similar to the windfall effects of inheritance.

We have, therefore, as one limiting conception, an equilibrium development without "exploitation" which requires a collectivist organization to eliminate the effects of inheritance and of the private ownership of land, so that no member of the community consumes the whole income-value of the output of his labour until the stationary state is achieved. Such a communistic arrangement would give a greater rate of development with interest showing a higher initial rate and a greater rate of fall, than one that allows of inheritance and the private ownership of land. In an individualist economy there will be an imputed value to all land from the beginning of development, and there could be only one initial distribution of land that would prevent exchange taking place between members of such a community (if inheritance effects could be eliminated). If such a distribution could be achieved (with the same assumption of no inheritance), there could be no subsequent decumulation of capital, however inextricably land and produced capital became interwoven. The private ownership of all wealth, including land, occurring in such a way as to lead to optimum economic development from the point of view of every member of a community, is thus not only a theoretical possibility, but would of necessity be included in the conception of the only theoretical optimum economy from the point of view of development (provided, of course, that we neglect new inventions).

Curiously enough, it contrasts sharply with the ordinary picture of a communist economy in implying a society in which the wealth is very unevenly distributed ; for such a distribution is required for the optimum distribution of income through time for the purpose of meeting the desires of its members. But collectivist intervention would still be required to deal with inheritance ; and the theoretical necessity that wealth be handed on to those who have the same labour-income attitudes as those who die would be an even more fantastic requirement. If, however, this could be done, the motive to die wealthy for the sake of prestige would be destroyed, and the consequent decumulatory tendency would have to be dealt with. Therefore, even in a world without new inventions, the existence of land and the necessity of inheritance destroy the possibility of an optimum equilibrium through time. If such an optimum equilibrium be the chief desideratum of an economic utopia the problem of the optimum social order has no obvious solution. Clearly, collectivist organization can go far to remedy the defects of any system that allows the effects of private ownership of land and inheritance to accumulate, even though a more equalitarian distribution of income and work, which seems to be an inevitable accompaniment of such organization, acts in the contrary direction. It is not even clear that there could not exist a system of drastic taxation of inheritances that would counteract the accumulation of effects due to haphazard land-ownership and inheritance in a capitalistic community, and would be superior (from the point of view of optimum development) to the alternatives advocated by collectivists.[1]

[1] This purely theoretical point is not meant to imply any conclusions as to the merits or demerits of collectivist systems. All social systems, involving the private ownership of wealth, seem to generate monopolistic class privileges ; and these privileges when combined with arbitrary land-ownership and inheritance seem always to generate those familiar and distressing results which defy both prevention and cure.

We may conclude then that optimum equilibrium-development is a mere theoretical possibility and a practical impossibility in any conceivable form of social organization, and that actual equilibrium-development for a community is both a slower development than this theoretical optimum, having, indeed, a lower initial rate of interest but a slower rate of fall. In the following chapters, therefore, we shall find it convenient to convey by the term equilibrium-development that modified equilibrium-development that would be consistent with the actual facts of land-ownership and inheritance in the community, whatever form these may take.

Chapter VI

DIVISION OF LABOUR

Having assessed the significance of the time-factor in development we can proceed to complicate our world on another plane by turning from the temporal to what we may call the spatial aspects of the problems of capital.

We assumed in the first place no division of labour. Actually, by combining labour, income may be increased in much the same way as by spreading it through time. As we increase the number of co-operating units we may more than proportionately increase income, though, after a point, this may be at a diminishing rate. A community will obviously tend to adopt that co-operative method of direct labour that gives the biggest income. If this principle of increasing returns operated with perfect continuity and without limit, development would be modified from the outset, owing to the fact that as lengthier methods replaced direct labour, the income-product of direct labour would fall owing to the diversion of labour to new methods, with some attendant loss in the sphere of direct labour of the advantages of division of labour. On the other hand, the new lengthier methods would become more productive in so far as they themselves gained the advantages of division of labour. In other words, the lengthier method becomes more productive the more fully it replaces the shorter, which, as its scale of production diminishes, becomes less productive. The rate of interest will thus tend to be lower at the beginning of what we have called (see Appendix to Chapter III) a "period of development", rising throughout the period. In so far as there is a limit to

increasing returns, we can assume that there may be a middle phase during which both methods are getting the full economies of division of labour, when the interest rate is constant at a figure higher than at the beginning of the phase of development and lower than at its end. There is a retardation of replacement at the beginning of a period of development, an acceleration at the end; but if we know the schedule of increasing returns for each method of production, the course of development will still be precisely determined.

It should be noticed that the term "capitalistic" is frequently used ambiguously to refer to any method which involves both capital and the division of labour. We shall require a more precise meaning, and propose therefore to call a method under which the ratio of income to capital in a stationary state using that method is less than in a stationary state using another method "more capitalistic", "lengthier", or "more roundabout" than this other. An establishment for growing pine-trees for timber is likely, in this sense, to be more capitalistic than the largest steel works. One method, in short, is more "capitalistic" than another if it is more dilatory.

Whatever theoretical device we may use to deal with the actual non-homogeneity of labour (the familiar points that are raised whenever the problem of the rent of natural ability and the quasi-rent of acquired ability are under discussion) there remains the special problem of entrepreneur-labour which reacts on development in a special way. We have already seen that the simplest equilibrium-development for a super-sapient Crusoe could only be achieved with difficulty. In the real world with its technical diversity and individuals of differing tastes, equilibrium-development is no more than a theoretical conception; but if there is a scarcity of the more far-sighted types exercising a preponderating influence in the choice of methods of production

(and in the real world of non-homogeneous income, of what to produce), they will tend to be rewarded only so long as they are not collectively so influential as to move the whole community along the equilibrium line of development; for if a payment is to emerge for the mere activity of choosing the appropriate methods of production, it must be because there is a lag in their adoption. If the appropriate degree of replacement of a less by a more capitalistic method took place, income by the new method would just suffice to pay the factors making it; but if less than this degree of replacement occurs, then the value of the new type of capital is raised and that of the old type lowered, and the owners of the new kind of capital gain at the expense of holders of the old. This gain constitutes the essence of what is called Profit, and is essential to development wherever ignorance and inertia are present as retarding forces. It is to be distinguished from monopoly profit where the restriction of output is deliberate; and also from the rewards got by such restrictive activities as the deliberate maintenance of ignorance and inertia in others. Although profit is a measure of the forces of inertia in development, it can only be regarded as a brake if we assume that there is no cost in securing the proper equilibrium through time. Since, in a planned economy, those who provide the labour of planning would need to be assigned some part of the total income, then development to that extent would be slower than if entrepreneur-enlightenment rained freely down from the skies, and development in a planned economy would be indistinguishable from that of an entrepreneur community with a total entrepreneur profit exactly equal to this assigned reward. It is possible, therefore, to include in the conception of equilibrium-development a labour-cost of arranging for that development to take place—a minimum profit income, or planning cost.

This interpretation of entrepreneur-profit seems, at first

glance, indistinguishable from that of Schumpeter. In the " circular flow "[1] there is no profit; but as resources are pulled from the " circular flow " and new methods adopted, profits temporarily emerge, and continue until these new methods are fully established. Now the " circular flow " is evidently the process of renewal of capital so as to maintain it stationary in quantity and quality (as would continue to happen if the state were a stationary one) and the entrepreneur prevents the community from becoming stationary by driving it forward. There is here, however, a difference of view and not merely of emphasis; for the view of this book is that there is a definite tendency towards equilibrium through time: the more development departs from its equilibrium course the stronger are the underlying forces impelling the community towards changes in the methods of production and the greater are the benefits that the initiators reap. It would be truer to say that the entrepreneur is forced by the community to emerge than that the entrepreneur forces the community to abandon its static condition. If the community is lacking in entrepreneurism then profits will be high and the brake on development considerable; and this should be regarded as a sign that other arrangements ought to be adopted rather than that the entrepreneur is well rewarded for blazing a trail, when, as a matter of fact, the road to be taken is already there and must eventually be followed by the community even if late in the day. The entrepreneur is not as such an inventor. The community has delegated to him the function of adopting new methods; and if the entrepreneur group fails to bring about the adoption of these at the equilibrium-rate each of the group makes a profit.[2]

Although the view of profits here stressed is, in the main,

[1] Schumpeter, *Theory of Economic Development*.

[2] A somewhat similar view has also been put forward by Dobb, *Capitalist Enterprise and Social Progress*.

the same as Schumpeter's, its acceptance does not necessitate our subscribing to his theory of interest. It would seem that, so far as I understand Schumpeter, the entrepreneur is faced with a difficulty in diverting resources from the "circular flow" and therefore has to obtain them by a trick. Purchasing power is bought from the banking system and this process enables the entrepreneurs to abstract the necessary resources from the "circular flow" and incidentally causes a price to emerge for purchasing power. That this, to a considerable extent, is a true statement of what does, in fact, happen, seems undeniable. It will even be suggested later that this is one of the main causes and *motifs* of the trade-cycle, not, however, as Schumpeter seems to imply, because it in any way helps a rate of interest to emerge, but because it causes an artificial lowering of the rate of interest and a consequent disturbance of the structure of production. It is because resources are ripe for being abstracted from the "circular flow" that the entrepreneur is required; and in so far as he is successful in his operations he causes future rates of interest to fall. The entrepreneur alters the distribution of interest rates through time. Only in the sense in which, but for the entrepreneur, the community would lapse into a stationary state, can he be regarded as a cause of the emergence of interest. We require one unit at least of entrepreneurism, one unit of thought about the future in order to have any development, and this will bring into existence a rate of interest. The more we add units of entrepreneurism, the nearer we shall get to equilibrium-development, the smaller will be entrepreneur-profits, and the lower will the rate of interest eventually be because at each moment we shall have been brought nearer than would otherwise be the case to that final Stationary State towards which "the whole creation moves".

The argument of this book does, however, agree with

Schumpeter's conclusion that " interest " if the term be used for the yield on specific capital, necessarily moves to zero in every business that does not develop new methods. For every method of production becomes obsolete; and if entrepreneurs are obtaining profits from new methods that are not being developed sufficiently rapidly, then losses are appearing in businesses that are not abandoning old methods sufficiently quickly. The capital of any business that does not develop appropriately must necessarily become worthless in the course of time. But this is not the general " rate of interest " with which we are concerned; and when Schumpeter goes on to say: " Interest is not, like profit for example, a direct fruit of development in the sense of a prize for its achievements. It is, on the contrary, rather a brake—in an exchange economy a necessary brake—on development, a kind of ' tax on entrepreneurial profit ',"[1] he is, to say the least, misleading. Interest is, of course, a brake on development, in the sense that it prevents a rate of development greater than the equilibrium-rate—in other words, it is a symptom of the rate of development: the higher the rate of interest over a period, the greater the rate of development. If there is insufficient entrepreneur activity, then there is insufficient development and the rate of interest is lower, while profits are higher: if there were more activity, interest would be higher and profits lower. Only in this illegitimate sense could interest be described as a tax on profits.

Perhaps these differences between two points of view, which are, in other respects, similar, result from a difference in the conception of development.[2] On the view put for-

[1] Schumpeter, *ibid.*, p. 210.

[2] Schumpeter makes no clear-cut distinction between the progressive adoption of lengthier methods of production resulting simply from the accumulation of capital and the progressive invention of new methods of production. In so far as Schumpeter's entrepreneur is an inventor who " thinks up new combinations " which would have been adopted sooner if only they had been discovered sooner, Schumpeter's " develop-

ward here there is an equilibrium-development which could be said to be present if entrepreneur profits were zero—just as static equilibrium is achieved if profits in all lines have been reduced to zero, so that all goods are being produced in the right proportions. Schumpeter also believes that there is determinate development in the sense that any economic situation necessarily develops into another, and that a full knowledge of all entrepreneur activity connected with this situation would render this development quite determinate. But possibilities of "new combinations" are infinite, and no activity on the part of entrepreneurs could abolish profits, if it were not for the rate of interest which their activity generates. This may be accepted without protest; but under our conception of equilibrium-development if ever entrepreneur activity succeeded in abolishing profits and raising the rate of interest to the level required by this situation, then development would be proceeding at the equilibrium-rate. But Schumpeter, as far as I can see, admits no such equilibrium. Interest, to him, is essentially a price paid for the use of purchasing-power; and when the banking system creates more and charges for it, it is still for him a brake on development; whereas on our view (put forward in a later chapter) there is, instead, an artificial stimulus. If there were no banking system to provide this purchasing-power then, according to Schumpeter, there would be stagnation in development. Against this view we shall argue in Chapter IX that the banking system provides what is really an artificial anti-social goad.

ment" is not the "development" that we have been investigating. The theory of development in the latter sense is a theory of capital accumulation and of general downward movement of the rate of interest. The theory of development consequent on the invention of new methods of production and new wants is in our view to be treated rather as a theory of disturbances that occur in the process of capital accumulation and of the consequent fluctuations in the rate of interest—a subject dealt with in Chapter VIII.

CHAPTER VII

REAL INCOME

Income is not a homogeneous good, nor even a bundle of commodities and services received always in bundles. Our equations were constructed on the assumption that income could be provisionally treated as a homogeneous good; and no special difficulties are introduced if our first step away from this extreme simplification were to be the assumption that real incomes are composed of the same constituents jointly demanded in invariable proportions. Every commodity will have a different schedule of productive methods, influenced amongst other things by the methods being adopted in the production of other commodities, changing with all the facilitations and de-facilitations that result from division of labour and the scarcity and heterogeneity of that unchanging[1] quantity of unproduced fixed capital, land.

Consider one commodity which constitutes a part of total income so small that development through new methods of producing it can be regarded as having a negligible effect on the rate of interest.[2] Then the amount of this commodity

[1] More strictly diminishing in so far as constituents are permanently removed from it.

[2] If we isolate for consideration any particular commodity, which is a small part of total output, we must, of course, assume that all other values both present and future must be taken as given. This would give us its equilibrium-output and value at any moment of time, these, of course, being determined by considerations familiar to all economists. Its developmental equilibrium is also given, since future rates of interest will be affected to an inappreciable extent by changes in its output. The precise extent to which at any moment resources should be devoted to longer methods instead of to a repetition of shorter methods is therefore given. But the relevant considerations are always future rates of interest, which lie more and more in the future as production in

to be produced on each successive day is determined, and its costs of production are determined. Beginning with an initial state in which the whole of the first day's income is the product of direct labour, there will be some resort to lengthier methods from the outset according as future rates of interest permit. For example, if the rate of interest a year hence—the value of the 365th day's income in terms of the 366th—is expected to be half that of next week, a method of production wholly excluded by the rate of this earlier future may yet be warranted by the rate of the later future. If the period of this method is one year, then, even on the first day of development, some production, however trifling, by this method, should be commenced. A similar situation arises for every other component of income ; and if the schedules of methods were exactly similar, there would be simultaneous parallel development in all branches of industry. It would then be possible to think of all capital as composed of homogeneous complex units (of the kind described in the first paragraph of this chapter)

general becomes more " capitalistic ". Dobb has pointed out (M. H. Dobb, " The Problems of a Socialist Economy," *Economic Journal*, 1933) that even if the rate of interest now is inappropriate to a particular investment now, that investment may yet be the most economical. The explanation of this lies, on the argument of this book, in the fact that the rate of interest at the moment is never the relevant consideration, and in so far as entrepreneurs or the community are unduly guided by observation of the present rate of interest, there will be in most cases a bias towards under-investment (i.e. the devotion of resources to longer methods of production to an insufficient extent). If a community behaves rationally with respect to one item of income, it will behave, to use Dobb's illustration, like a dog which calculates the future position of a bicycle correctly and so reaches its goal along a single appropriate straight line instead of along a series of changing lines. But if the community becomes generally more rational, the speed of the bicycle is also changed, and what would have been rational investment in a particular line of production, will again have become irrational. On two grounds, therefore, a planned economy may give more economical results than an entrepreneur economy. Future rates of interest (valuations of the income of one future in terms of the adjacent future) may be made more appropriate to disutilities and utilities through time; and particular investments may be undertaken with fewer mistakes, since the time distribution of income and therefore future rates of interest have been brought under fuller control.

each sub-unit maturing into its appropriate income form at its appropriate date.[1]

Let us now suppose that the schedules of methods of production are not similar. For example, let there be one commodity that can be produced only by direct labour. Then, as income expands and labour diminishes, more and more labour must be devoted to this constituent of income, instead of less (since we have assumed that it continues to fill the same proportionate space in the expanding income), and therefore less is available for the production of other commodities; but since we are assuming that all are jointly demanded, less provision can be made for the expansion of the production of other commodities, and the rate of interest falls more slowly (i.e. the "period of development" from one method of production to the next with its appropriate interest-rate, is lengthened for all these other commodities). If, on the other hand, for one commodity the schedule of productivities of capitalistic methods showed a greater rate of increase of productivity

[1] Since even static equilibrium never has time to be achieved, the required expansion of output will not in practice be correctly performed. Losses will be sustained by those who over-expand and gains by those who under-expand, and these in the usual way will bring about the required corrections. When development is further complicated by new inventions and elastic credit these mistakes will, at times, dominate the situation. If demand is expected to expand in one particular direction then, since under competition resources must be committed in advance, over-expansion is likely to occur, because individual producers have no foreknowledge of the behaviour of other producers. But under what we have been treating as "normal" conditions, such over-expansion must be at the expense of other industries, and equilibrium will in due course be restored. If this phenomenon of over-expansion covered simultaneously large parts of the field of industry it would mean that entrepreneurs had ceased to be scarce and that profits were becoming negative, producers in unaffected industries gaining at their expense. Under abnormal conditions of unemployment of resources, this phenomenon is more marked but less significant; for entrepreneurs, for whom normally there is a price, will also be unemployed and will hurry to get in first wherever there appears a chance of profits provided that competitors do not turn it into a loss. A world in which values have become so completely maladjusted as to give general unemployment we are not at present discussing, since it could not arise under the operation of those economic forces we have so far considered.

with a given lengthening of the period of production, labour would be released for the production of other commodities; and therefore "the period of development" for other commodities would be shortened, and the rate of interest would fall earlier than would otherwise have been the case.

With the schedule of methods different for every commodity, the equilibrium course of total development involves the full adoption of the one appropriate capitalistic method that is suitable for that one commodity whose schedule of productive methods shows the most rapid increase of productivity with a given amount of lengthening, while the extent of the adoption in the case of other commodities is, for the time being, less than would have been the case if the methods specially favouring development of this one commodity had not been available.

Labour is thus gradually released for use by the lagging industries until with only one industry left in a state of incomplete development, the last phase of its contribution to total development is rushed to completion, the rate of interest falls and development in all industries begins afresh. Division of labour acts in a similar manner; for as each industry develops its appropriate capitalistic method, its initial development is accelerated through the increasing-returns effect as it becomes organized for the new method. (This, of course, is partially offset, as previously pointed out, by the reduction of the advantages dependent upon the division of labour in those parts of the field where the older methods still need to be retained.)

Let us now drop our assumption of a "homogeneous complex income" and assume that the constituents of income change their proportions as capital accumulates and income grows. Let us assume that every constituent can be produced by direct labour and let us continue to define the amount of income represented by any constituent as the amount of direct labour required to produce it. The

amount of any income, however constituted, is thus an unambiguous quantity, and our equations of development continue to hold precisely.

As income increases under development constituents are being substituted for one another for three separate reasons. Let us first suppose that the schedules of increasing productivity from lengthening are similar for every commodity and that there is no economy from division of labour, then the adoption of lengthier methods will take place simultaneously for all commodities ; but a larger proportion of some commodities will be produced and a less proportion of others. In this case, though relative values remain unchanged, expansion of total income may be expected to lead to the partial abandonment of some items in favour of others, even though they are not necessarily substitutes in the narrow sense of the word. Let us next suppose that economies from division of labour can be obtained more readily in the production of some commodities as compared with others and in ways which may vary as lengthier methods are adopted, then there will be some relative increase in the production of those commodities most subject to increasing returns, so that there is now substitution on account of the change in relative values (owing to the change in relative labour costs of production on account of division of labour as distinct from roundaboutness). Lastly, let us suppose that the increased productivity from a given lengthening of production is greater for some commodities than for others, then products showing a greater increase of productivity from lengthening will be lengthened first, until, owing to the abandonment of direct labour, the rate of interest falls to the point that allows of the introduction of the next longer method for this commodity, if it were not for the fact that before this point is reached the increased productivity from lengthening the processes of production of other commodities may be likely to check this fall in

the rate of interest (according to the various schedules of increase of productivity from lengthening shown by all other constituents of income). In this case the relative values of those commodities first to be produced by lengthier methods will fall as soon as the rate of interest drops to introduce the more roundabout production of other commodities, and this fall in relative values may lead to some substitution of the former commodities for the latter.

One practical objection to retaining our definition of quantity of income when income is not homogeneous may be raised on the ground that many commodities cannot be produced by direct labour. This difficulty can be met by assigning to all commodities not produced at any stage of development by direct labour a labour-cost such that the commodity, even if it could be produced at this labour-cost, whether at this first or at any other stage of development, would just not be produced. The stage of development at which this commodity enters into consumption is then determined by the considerations given above.

There may, of course, be some commodities which, although capable of being produced by direct labour, do not enter into income at the first stage of development, owing to complete substitution by other commodities; and such commodities, even though produced by direct labour, may, when incomes have increased, be substituted for other commodities. (Various personal services might be taken as illustrations of this sort of "commodity".) In this case the amount of the commodity which constitutes a unit of income is, of course, the amount produced in the advanced community by a unit of direct labour.

It must be insisted that the definition of a unit of income is for us mainly a question of its convenience as an aid to the solution of the problem of economic development. We have been investigating the consequences of *differences* of productivity consequent on roundaboutness of production,

and these *differences* are unchanged whether we call both a consumed strawberry and a day's occupation of a house a unit of income, or the former 1 unit and the latter 1,000 units. The definition of a unit of income suggested above is the definition that allows the equations of development given earlier in this book to exhibit, in the simplest way, even after the assumption of a homogeneous income has been removed, the essential features of equilibrium-development.

So long as we assumed income to be homogeneous, any unit of income on a particular day was necessarily equal in value to any other unit on the same day, so that the income-value of labour and capital and the income-value on that day of the income of other days (i.e. the rate of interest) had a quite simple meaning. But with a non-homogeneous income, particular units of income may have quite diverse values on any particular day, so that the meaning, in any absolute sense, of the income-value of labour, capital, and income of other days, changes from day to day as the constitution of income changes. Our equations of development enabled us to exhibit the values of labour, capital, and income of other days in terms of the income of a particular day, and, therefore, in terms of one simple unchanging unit of income, only because income was assumed to be homogeneous. When this assumption is dropped, income-values from day to day can only be realistically compared if we can state the relationship between a unit of one income, that is constituted on one day's plan, and a unit of another income, that is constituted on another day's plan. The relationship we require is, of course, some utility relationship; for there are only two aspects of income that have economic significance—cost on the one hand and utility on the other. Cost we have used for defining a unit of income, and utility alone remains to relate one unit of income to another differently constituted unit.

If we take the case of Crusoe, the relationship we are seeking is given by Crusoe's indifference to varying amounts of differently constituted incomes.[1] Let the quantity of Crusoe's income on any day x be C_x and let the constitution or plan of his income on any day x be indicated by B_x, B_x having what may be called a number of dimensions equal to the number of different commodities in the xth day's income. $\frac{B_x}{C_x}$, therefore, may be taken to represent the plan of a unit of income on the xth day—i.e. on the xth day Crusoe consumes C_x units of a composite commodity $\frac{B_x}{C_x}$, and this composite commodity is a unit of income. The problem we have to solve is the relationship between units of income on different days, so that we can take the statement that "the income-value on any particular day of that day's labour (or of that day's capital, or any subsequent day's income)" has increased or decreased at one time as compared with another time, when the income-unit is changing in its internal structure, and translate it into a statement of values that is the nearest attainable equivalent to a statement in terms of an unchanging standard.

If we compare the income C_x, on plan B_x, with the income C_{x+1} of the next day, on plan B_{x+1}, we can find an income ${}_xC_{x+1}$, on plan B_x, towards which Crusoe is indifferent as compared with income C_{x+1} on plan B_{x+1}. Let us call this income an "equivalent" income. Then the unit of the $(x + 1)$th. day's income is "equivalent" to $\frac{{}_xC_{x+1}}{C_{x+1}}$ units of the xth day's income.[2]

[1] See Hicks and Allen, "A Reconsideration of the Theory of Value," *Economica*, 1934.

[2] It might be suggested that a more satisfactory meaning for "equivalence" of units of two equivalent incomes is given by the marginal utility of the one income divided by the marginal utility of the equivalent

Although " equivalence " can thus be found between Crusoe's income on one day and any differently constituted income, and therefore the number of units of income on one day equivalent to a unit of income on another day can be stated, it does not follow, if z_1 units of to-day's income are equivalent to z_2 units of to-morrow's income and z_2 units of to-morrow's income are equivalent to z_3 units of the next day's income, that z_1 units of to-day's income are equivalent (when to-day's income is compared directly with the day-after-to-morrow's) to z_3 units of the day-after-to-morrow's income. We must, therefore, choose our method of calculating derived equivalence on some arbitrary plan according to the kind of significance we wish to extract from the statement that income-values are changing in a certain way through time.

But since we are rarely interested in the " equivalence " of incomes remote from one another in time, it is only the " equivalence " of adjacent incomes that is worthy of close consideration. If the income-value of labour has increased ten-fold over a century, the number of units of the original income equivalent (in this direct sense) to the unit of that income of which ten times as many units can be purchased now with a unit of labour as compared with a century ago is of very little significance. The relatively simple plan on which to base the relationship of units of income, as the constitution of income changes, is to define the number of units of income of one day which are equivalent to a unit of income of another day as the product of the equivalences of each and every pair of adjacent days lying within the period under investigation (a method that recalls the chain-method of constructing an index-number). This, in the

income. So long as we do not attempt to establish direct equivalence between very differently constituted incomes the above definition will not differ appreciably from the one we have adopted; and for very differently constituted incomes the very concept of direct " equivalence " is of doubtful value.

above example, makes z_1 units of to-day's income "equivalent" (in this arbitrarily chosen sense of "equivalence") to z_3 units of the day-after-to-morrow's income.

If we consider Crusoe's development from the first day on which all income is direct, then, as Crusoe's income changes in quantity and constitution from day to day, a multiplier, E, (or E_x for any day x), to express the equivalence of income-units, emerges, and this multiplier increases slowly from unity as development proceeds, and, when multiplied on any given day by the income-value of labour, capital, or income of some other day, on any given day, enables us to make a more or less satisfactory "real" comparison between income-values of one day and income-values of another day. Since the income-value one day of the income of another day is a way of expressing the rate of interest between these two days, then, if E_x and E_y are the multipliers of the units of income of these two days required to give equivalence to the units, then the rate of interest multiplied by $\frac{E_x}{E_y}$ may be called the "real rate of interest" as between these two days.[1] (And this real rate will not be appreciably falsified however large E has become, provided x and y are reasonably close in time, since the absolute magnitude of E does not appear in the result but only the ratio of the E of one day to the E of another day in close proximity.)

When we come to community development, we have to remember that substitution is carried a step further than is the case with Crusoe, owing not only to the different sizes of individual incomes but also owing to the varying utility schedules of different individuals. The income of

[1] This of course is not what is usually meant by "real rate of interest" (i.e. the contractual money income of lenders of money, corrected for changes in the value of money during the period of the contract) since our multiplier gives a different meaning to changes in the value of money from those given by any of the usual index-numbers.

each individual thus tends to be different in constitution from the constitution of the representative income of the whole community. Each individual may be regarded as substituting for his representative fraction of the total income (i.e. for that number of units, $\frac{B_x}{C_x}$, of income to which he is entitled) that income of equal value for which he has the greatest preference; while the community's total income of that day is itself of constitution B_x as a consequence of this process of substitution being carried out by every member of the community, each influenced by a different set of personal preferences.

Let the income of any given member of the community be c_x, constituted on plan b_x, when the communal income is C_x, on plan B_x, and let ${}_xc_x$ be that member's income, on plan B_x, which is equivalent to the income c_x. Then $\Sigma_x c_x$, where $\Sigma c_x = C_x$, is the sum of individual incomes on plan B_x equivalent to the actual income C_x, distributed as an income c_x on plan b_x, c'_x on plan b'_x, and so on, for each member of the community respectively. We can proceed in the same way on the next day $(x + 1)$ and find the sum of individual incomes on plan B_{x+1} equivalent to the actual income C_{x+1}, and also the sum of individual incomes on plan B_x equivalent to the actual income C_{x+1}. This gives us the sum of individual incomes on plan B_x equivalent to the sum of individual incomes on plan B_{x+1} equivalent to the actual income C_{x+1}. Let the total income on plan B_x equivalent to this sum of individual incomes on plan B_x be ${}_xC_{x+1}$. Then we have ${}_xC_{x+1}$ equivalent to C_{x+1}, and, therefore, the number of units of actual income on the xth day equivalent to a unit of actual income on the $(x + 1)$th day is given by $\frac{{}_xC_{x+1}}{C_{x+1}}$. We can now proceed as we did with Crusoe and construct a multiplier E (or E_x on any day x) which converts each day's unit of income into an equivalent

unit and we can thus obtain an " absolute " meaning (in the only sense of the term that seems permissible in this connexion) for income-values on any day.

The relative values of income-constituents on any day will in a money-economy be given by prices ; and thus the attempt to find a meaning for equivalence of income at different times may be regarded as an attempt to find a meaning for the relative income-values of money at different times. In so far as the unit of income, as actually constituted on any day, has the same money-price on any day, then statements of movements of the various income-values (of labour, of capital, and of the income of other days) during development (as given in the appendices to Chapters III and IV) may be expressed in terms of money, and the rate of interest may be expressed in the usual way as a money rate. But the " value of money " is in this case necessarily changing ; but it must not be overlooked that when we are investigating the development of values through time with a view to expressing the true rate of interest in the form of a money rate, what we require is not those corrections for changes in the " value of money " that the usual theory of index-numbers has in view, but the " value of money " must be deliberately allowed to change appropriately through time in accordance with the movement of our multiplier E.

Let us now consider the implications of equilibrium-development under conditions which we have attempted to make realistic, except for the provisional exclusion of new inventions, of catastrophes and of windfalls.[1] There will be, of course, no profits ; and most industries producing income-goods will be expanding, the exceptions being those producing goods for which other goods are being substituted at a rate greater than the increase of income. All or some industries are moving to lengthier methods of production.

[1] We shall, however, continue to assume a constant population.

The slower the change in some industries the more rapid is the change in others; and the rate of fall of the "rate of interest" will be the resultant of what is happening in all industries. There will, of course, always be some industries that change little over long periods (owing to the non-existence of lengthier more productive methods) and this appropriate stagnation may be accentuated by the presence of an unchanging demand as income increases, so that such industries cannot reap the advantages of any further division of labour. Moreover, some industries may be contracting not so much because of the absence of an increasing demand, but owing to the rising value of the particular kind of land that happens to be required.

At any such moment labour is being applied in a way that will lead to the emergence of different quantities of different items of income at various times in the future, so that rates of interest over the period during which such income will emerge are being established as a consequence of past and present acts of investment, i.e. by decisions to apply labour in more and more roundabout ways than previously (these earlier decisions being assumed to have been correct decisions). All the various kinds of capital have, therefore, a value in terms of present income, which can be calculated by reference to future rates of interest, rates already in part established and rates that will continue to be established in a determinate way over the whole future during which income from existing capital will emerge; and these values will, of course, be such that it cannot at any time be said that the various kinds might with advantage have been produced in any other proportions. The value of every kind of land is imputed in precisely the same way, though the amounts of it have never been a matter of choice, except in so far as constituents have been abstracted from it.

Our general statements about the nature of development

need then no significant alteration to meet, in the absence of new inventions and windfalls, the facts of the real world; such development would show the following general characteristics. We should find a rate of interest falling through time and tending ultimately to fall to unity (i.e. 0%); for, once development has proceeded some distance, the great variety of kinds of capital, whether working or fixed, consequent on the great variety of goods composing income, will tend to smooth out those slight oscillatory movements to which attention was drawn in dealing with simple capital development (see Appendix to Chapter III). This falling rate of interest is an expression of decisions as to the use of resources (labour and land), decisions which as development proceeds become more and more remote from the period over which any given rate of interest holds. As the rate of interest falls, so does the rate of investment, and in general, the rate of saving, until, in the stationary state, the rate of interest is unity and saving is zero. As development proceeds income increases, and capital increases faster than income, reaching a maximum in the stationary state; and the income-value of any particular kind of capital a given distance from maturity rises (over the period during which it still continues to be found at that stage of maturity) by an amount given by the future rates of interest over the period during which it matures into income. Particular kinds of fixed capital may, however, fall in income-value to zero and be discarded.

Since land cannot be increased in amount, nor substitutable fixed capital be economically produced to any appreciable extent; and since land deteriorates to some extent through the using up of its constituents, the rise in its income-value is likely to be considerable; and in so far as particular units of land give perpetually some components of income without labour (e.g. amenities), the income-value of such land will rise without limit as the rate of interest falls.

But any particular unit of land may move in income-value in any way, alternately rising and falling, so that it is not impossible that the total income-value of land should fall throughout any particular phase of development; for produced fixed capital which is valuable early in development may become valueless, and there is no reason why particular units of land at first of great value, should not also be affected in the same way.

Throughout development, labour rises in income-value as the rate of interest falls, until, in the stationary state, labour and land together receive their whole income-product.

Owing to inheritance and the arbitrary initial ownership of land, equilibrium-development is considerably slower than would be the case for a community the members of which behave as if they were immortal, as a result of the decumulations that are likely to accompany both any rise in the value of land as well as the passing on of fortunes. The negative saving of those who decumulate can be regarded as something that reduces the rate of fall of interest and lengthens the whole period of development, so that the rate of interest is higher than it otherwise would be, and income-values of capital and labour less than they otherwise would be. Since land-ownership once established in a particular way produces effects that are more or less calculable and since inheritance is a gradual and more or less calculable influence, development at this lower rate may still be regarded as a form of equilibrium-development, the values of different kinds of capital being such that there is no reason to feel that their proportions are inappropriate.[1]

[1] A different approach to this question might have been adopted, inheritance being regarded as a recurring accident which reshuffles the wealth of the community in an arbitrary way. But there is some sort of actuarial basis for conclusions relating to the wealth redistribution that is due to inheritance, while there is little or none for new inventions, windfalls, and catastrophes. It seems undesirable therefore to treat equilibrium-development as meaning that development which would take

Actual development is further, of course, retarded by that inertia that gives rise to profits. The presence of profits means that less roundabout methods are not abandoned in favour of more roundabout methods with sufficient rapidity to meet the community's real desire to save when income has reached a certain level. At any moment there is too much shorter-period capital, too little longer-period capital: the owners of the latter gaining, the owners of the former losing. Or else, as income changes, and its constitution changes, it becomes advantageous to increase the production of certain commodities more than of others; the change is not being made sufficiently quickly, and those who start fresh production in the industries of substituted demand, even when new methods are not yet required, make profits that are offset by losses on the part of those who own the superabundant capital in the relatively contracting industries. Or finally, since longer methods of production as they become adopted open new fields for division of labour, the lag in the adoption of such division of labour by those entrepreneurs who are already receiving profits from the more capitalistic methods allows those who are the first to increase this division of labour to profit at the expense of those who are late. In all these cases, moreover, many may mutually profit from the emergence of external economies which, not being fully foreseen, may not have attracted the amount of enterprise which would have prevented this extra gain.

place with perfect calculation and the assumption of continued ownership of capital by individuals acting as if immortal, and to regard every wealth redistribution due to inheritance as an accident moving the community off the line of equilibrium-development.

CHAPTER VIII

INVENTIONS

No hard and fast line can be drawn between the realization of what can be done, in the absence of new knowledge, and the discovery of new methods. The entrepreneur shades off into the inventor. There are methods of production involving greater roundaboutness as well as methods utilizing a greater division of labour, which, though not calling for new technical inventions in the narrow sense, must be regarded as requiring the equivalent of an inventive act which is as unforeseeable as any form of invention. Even when a community is ripe for the utilization of such methods, no entrepreneur may come to the scene to introduce them. In order to be realistic, we propose, therefore, not to limit the term inventions to technical discoveries, but to use it to cover any sufficiently revolutionary change in organization, whether or not this involves purely technological innovation. Changes on the side of demand that involve changes in the constitution of the unit of income may also conveniently be regarded as inventions.[1]

The peculiarity of an invention lies in the fact that it cannot be foreseen. Inventions do, of course, grow out of one another with a slight degree of predictability, but for the present discussion we shall generally confine the use of the term to those that may be regarded as sheer accidents. In a sense, of course, the entrepreneur is also an accident; but since he is always destroying his own profits, we can

[1] The phrase "invention of new wants" will be taken to cover changes in demand schedules even when the appearance of a new want causes a diminution of other wants. New wants are rarely sheer additions to existing wants, just as increases of an individual's supply of labour are rarely sheer additions to his total flow of activity.

still speak of an equilibrium-development which is tending to be achieved by his aid rather than of the creation of a new equilibrium produced by his interference.

Let us revert for a moment to the simple world of homogeneous income, and let us suppose that the community is in equilibrium at some stage of development, and is, therefore, progressing from shorter to longer methods and is in possession of appropriate amounts of various kinds of capital having appropriate values. Let a new invention appear which makes it possible to produce a larger output with less labour by a shorter method. Let us assume that capital is of the simple kind, as treated in Chapter III, and let us suppose the community is in a period of development, abandoning a method of period P_1 and productivity C_{P_1} in favour of a method of period P_2 and productivity C_{P_2}. Let the new method have a period P and productivity C_P.

At the moment the new invention appears, income for P_1 days hence has already been determined, and a part of the income for the period P_1 to P_2 days hence. Since $P < P_1$, any resort to the new method of production increases income P days hence, and, since there must be some resort to it, income must be increased over the period P to P_1 days hence and, therefore, the rate of interest rises on the $(P-1)$th day; and since there will be a progressive resort to the new method, the rate of interest will be higher on each of the days P to P_1 days hence. Therefore, the income-value of all P_1 capital which is less than (P_1-P) days old and all P_2 capital which is less than (P_2-P) days old, will immediately fall. Since the rate of interest up to $(P-1)$ days hence is necessarily unchanged, the value of such capital as matures in less than P days will remain unchanged. For the period P_1 to P_2 days hence, P_2 income has already been determined, but the distribution of labour between the P_1 and the P method is under control (under the assumption of Chapter III that the income must be consumed on the

day of emergence), and the P method will progressively displace the P_1 method, and for income that will mature more than P_2 days hence, labour can be appropriately distributed between all three methods, until the P method has the field. It should be noticed that the P_1 and P_2 methods will not be immediately abandoned for the same reason that longer but more productive methods of which the community is aware are not immediately adopted: just as there is an equilibrium rate of adoption of the latter, so also is there an equilibrium rate of abandonment of longer less productive methods for shorter more productive methods.

We have already seen that proper development (i.e. apart from inventions) implies a rate of saving, which is the result of earlier decisions to commit a certain proportion of resources to longer methods of production. An invention such as we have described above requires a reversal of this process until the longer methods are eliminated. Labour which would have been devoted to the P_1 or P_2 method is in part devoted to the shorter P method, i.e. there is a disinvestment involving later dissaving until the P_1, P_2 methods have been eliminated. The progressive investment in new methods of production that are the result of new inventions does not necessarily require any saving on the part of the community, and, in fact, may require dissaving, if the new methods are shorter.

A somewhat similar situation results from the invention of new wants. This may be regarded as a sudden rise in the marginal utility of given incomes.[1] If the community is developing from method P_1 to method P_2, income is now

[1] We are retaining for the moment the assumption of homogeneity of income, so that a new want is simply an intensification of the old want. If we allow for the actual heterogeneity of income, then a new want may be looked at as if income were now wanted sooner—the community being, as it were, thrust back into an early stage of development as regards part (the new part) of its income, with the future temporarily more subordinated to the present.

wanted sooner, and capital falls in value the further it is from maturity: instead of an increasing devotion of labour to method P_2, we now have method P_2 progressively abandoned in favour of method P_1 (and conceivably both may be progressively abandoned in favour of still shorter less productive methods). The community dissaves, until eventually it retraces its steps and the rate of interest again begins to fall and a positive rate of saving again emerges. The essence of the situation is not altered when we drop the assumption of homogeneous income; for it will still be the case that there is an increase in demand for consumption goods and a tendency to *dissave*. There is emphatically no expansion in the demand for capital in general, as some writers have asserted,[1] because the increase in the demand for consumption goods necessarily involves a decrease in the demand for capital (though this may be masked in a community with much unemployed labour).

The new want also, it may be pointed out, tends to thrust the attainment of the stationary state into the more remote future. The increased demand may be expected to mean some increase in labour—utility and disutility balancing one another at a higher level. An extreme practical case might be that of a community in Africa which has virtually achieved a stationary state at a low level, but finds its labour-activity and income raised to a much higher level by the sudden importation of such things as bicycles and gramophones.

New inventions raise the rate of interest; but some may increase the rate of saving instead of causing dissaving. For example, if the period P in the above illustration were identical with the period P_2, but C_P were greater than C_{P_2}, method P_2 would be immediately abandoned in favour of method P, but method P_1 would continue, though it would be progressively abandoned at a greater rate. Income would

[1] Durbin, *Purchasing Power and the Trade Depression.*

increase suddenly P (which is equal to P_2) days hence, and the rate of interest would rise on that day, and would then move to

$$\left(\frac{C_P}{C_{P_1}}\right)^{\frac{1}{P-P_1}}, \text{ which is greater than } \left(\frac{C_{P_2}}{C_{P_1}}\right)^{\frac{1}{P_2-P_1}}.$$

But the period of development is shortened, and transition to remoter methods is achieved earlier and with a lower rate of interest than would have been the case without the invention.

If P, the period of production of the newly invented method, is longer than P_2, but method P is proportionately more productive than method P_2 (in the sense given in Chapter III), but less than P_1, then P_1 and P remain in the field with a rate of interest

$$\left(\frac{C_P}{C_{P_1}}\right)^{\frac{1}{P-P_1}}, \text{ which is greater than } \left(\frac{C_{P_2}}{C_{P_1}}\right)^{\frac{1}{P_2-P_1}}$$

since otherwise P would fail to compete, until P_2 had completely superseded P_1.

Therefore, whether or not the new method is more or less roundabout than either of those in the field, the rate of interest is raised at the end of one production-period of the new method, and at the end of a determinate period falls to a lower level than would otherwise have been the case. The situation may be represented as shown in Fig. 4, p. 161.

An invention of new wants (that do not on balance displace old wants) necessarily raises the rate of interest and may raise it for a period of indefinite length above what it would have been. If new wants appear sufficiently rapidly, the tendency of the rate of interest to fall as a result of development and the ultimate tendency of the rate of interest to fall still further as a result of the invention of more productive methods, may, of course, be checked to any degree. But it may be worth noting that in practice

the creation of new wants and the invention of more productive methods tend to be connected: new objects of consumption are invented as a consequence of the invention of more productive methods; and inventions in either class stimulate inventions in the other class,[1] so that the effect of either on the long-run rate of interest tends to neutralize that of the other. It is particularly noticeable, at the present day, that any technical improvement in industry stimulates

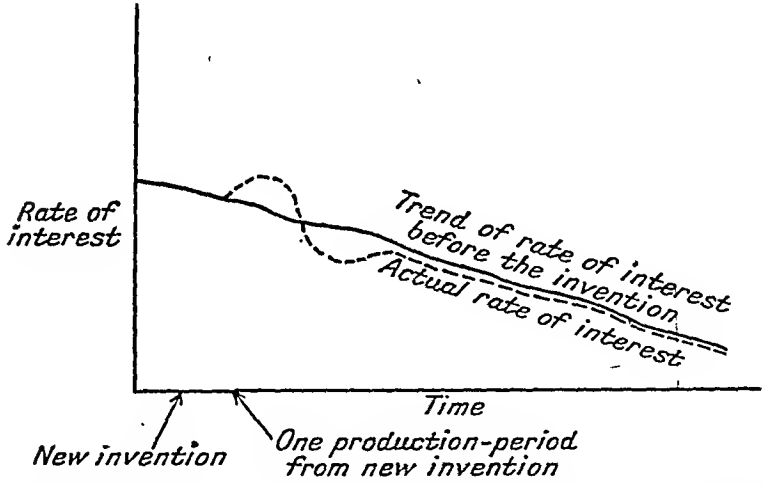

FIG. 4.—Effect on the rate of interest of the invention of a more efficient method of production.

the invention of new commodities which can now be more readily produced, and the fall in the rate of interest is, at the very least, postponed.

Not only do deliberate inventions disturb the course of development, but catastrophes and windfalls outside man's control may produce similar effects. A pure windfall or pure catastrophe that affects income but of which there is no prevision, hardly calls for any special consideration, for the structure of production cannot instantaneously be

[1] In the case of things like the cinema, does the egg come before the hen, or the hen before the egg?

altered. But any unforeseen change in the amount of capital is equivalent to a foreseen change of income and this is the type of catastrophe or windfall that it is important not to neglect. If it thus becomes clear that income over a future period will be less than had previously been anticipated, there will be an attempt to increase it by adopting shorter methods at the expense of longer, and over a certain period there will be a rise in the rate of interest. Suppose, for example, that it becomes known that income 50 days hence will for a further period of 50 days be less than previously expected, then, if there is no known way of rectifying the situation, the rate of interest on the 50th day will fall to a figure which might be negative, will return during the next 50 days to more or less the original figure, and rise to a high figure on the 100th day. All simple capital 50 to 100 days from maturity will, therefore, rise in value. In so far as new capital can be produced which will mature within this period, labour will be devoted to it, if the difference in productivity of this less capitalistic method is not such as to be prohibitive. This will mitigate the fall in interest; but as labour has been abstracted from the longer method producing income more than 100 days hence, income more than 100 days hence is diminished, so that the rise in the rate of interest on the 100th day is mitigated, while the rate of interest for a determinate period beyond the 100th day is higher than it otherwise would have been. In other words, income is removed from the remote future to fill a gap in the near future. Labour is turned from longer to shorter methods, and the future rate of saving over a determinate period may thus become negative. Saving is postponed.

A foreseen windfall income, as soon as it is expected, begins to act in precisely the opposite manner, raising the rate of interest in the near future, lowering it in the more remote future, while resources are devoted to longer

methods, so as to transfer portions of income from the favoured period to the more remote future, and the future rate of saving is, therefore, for a time increased.

The abandonment of an old want, it may be remarked, produces effects similar to those attending a windfall income.

It should be noticed that whether we have windfall or catastrophe, development is only temporarily diverted from its original equilibrium course, and this original course of development will be picked up at a later date, with either a gain or a loss of time.

An alternative way of looking at the effects of inventions and windfalls on the rate of interest is obtained by turning the series of rates of interest from day to day into a geometric mean over a period. An influence which moves the rate of interest in one direction in the earlier part of the period and in the opposite direction in the later part, will cause the geometric average rate of interest from the first moment of movement of the rate of interest to any later moment to move up and down in a way directly calculable from the movement of the rate of interest from day to day. The short period rates of interest of ordinary usage are, of course, such averages of rates of interest in our sense.

New inventions that cheapen methods, as well as windfalls and new wants, raise, while catastrophes lower, these average rates over short periods. New inventions that cheapen methods and windfalls lower these rates over longer periods (calculated from the same initial point of time) while new wants and catastrophes have the opposite effect.

We have already seen that in the absence of windfalls and inventions development proceeds smoothly in the sense that every method of production moves gradually to a maximum and then diminishes as a new method expands to compete with it. There is an absence of fluctuation. But

windfalls and inventions necessarily interfere with this smooth progression, and one to-and-fro oscillation in this process of substitution necessarily occurs, accompanied by a similar oscillation in the rate of interest. In a world of neutral money this would be of no great importance. In the actual world the case is different. And the main purpose of our later chapters is to show that, owing to the existence of elastic credit and contractual interest, such oscillations being amplified and repeated, become what are known as " cyclical fluctuations ".

When we allow for the non-homogeneity of income, we must remember that windfalls and inventions apply, in general, only to particular constituents of income and particular kinds of capital or land. A technical invention applying only to a particular activity is unlikely to have any appreciable effect on the rate of interest and may be neglected. But technical inventions frequently reduce costs over a whole range of industries, in which case the general rate of interest will clearly be affected. Whether or not this leads to longer methods in the industries affected, methods will tend to become shorter in all other industries to the extent to which this is possible and desirable, thus mitigating the changes in the general rate of interest, and mitigating the consequent oscillation. After at least one period of production by the new method has elapsed, the rate of interest will fall and the movement in other industries to shorter methods will be reversed, longer methods again becoming more economical and the original equilibrium course of development being recaptured. In practice, also, technical inventions of any magnitude are almost certain, as has been argued, to be associated with the creation of new wants. The rise in short-period rates of interest will, therefore, be magnified and the resort to shorter methods of production throughout the rest of industry

increased, though the subsequent fall in interest rates will be less pronounced.

The necessity for this oscillation can be seen by looking at the situation somewhat differently. Let us suppose, for simplicity, that the new invention lowers costs in half the industries of the community and that the constituents of income are demanded in approximately unchangeable proportion, then resources must be dragged from the remaining industries, with the virtual promise that they will be released again in more than full measure as the advantages of increased productivity are realized. By reverting to shorter methods, these latter industries can accommodate the others, at the expense of future output, which is temporarily contracted, but can be made up later when resources are again released for their use, as the improved industries reap the advantages of greater productivity. When a new invention affects one group of industries, it is those industries whose costs are not affected by the invention that especially suffer an oscillation in their structure of production, while progress to a new method of production takes place with the minimum of oscillation in the industries directly affected.

Under primitive conditions the appropriateness of such an oscillation is more apparent. The inhabitants of Faraway Island laboriously burn the jungle, till the land, and plant their yams and sweet-potatoes, and keep their fish-nets in repair rather than live on wild berries. A ship is wrecked on the reef; valuable stuffs of all sorts are to be had, if resources are marshalled to take advantage of this new, more productive method of gaining income. They would indeed be foolish savages if they troubled to maintain the capital devoted to food production, since there must be less capitalistic methods available; and so gardens will wisely be allowed to revert to jungle while income for the time is constituted by wild berries and the products of the new industry. But each new wreck has a smaller marginal

utility, and back to capitalistic food production the islanders will eventually go; and owing to the income temporarily obtained from the new industry, and the consequent saving of labour, even more capitalistic methods may be adopted than were visualized before.

If industries are in developmental equilibrium, each industry has achieved that degree of roundaboutness which would enable no mutual exchange of present for future resources to give any economic advantage. If, e.g., industry A by becoming less roundabout can produce a given quantity of product over the next 3 months by sacrificing future output and releasing labour for use in industry B so that in 2 months' time B requires less labour than before; then if so much labour is in turn released for A that by this double transfer of resources total output is finally increased as compared with what it would have been, the conclusion follows that this arrangement is economical. In other words, industries compete with one another through time, so that those that would profit most by being more roundabout can only do so at the expense of those that would profit least by such a change within their own structure. It is, therefore, inevitable that technical inventions, by altering these relative positions, should force all those industries that are not affected by the invention to become less roundabout, if, before the invention appeared, they were in equilibrium. And it also follows that when in the improved industries the demand for labour falls, the temporary reversion to less roundabout methods in other industries will have increased the demand there, and since the new invention is economical, the income-value of labour must have risen (unless the share of land has unduly increased).[1]

[1] Pigou appears to regard it as possible that an invention, if labour-saving, should not benefit labour absolutely, on the basis of factor distribution analysis. See *Economics of Welfare*, 1928, part iv, chap. iv. The above considerations suggest that labour must always benefit.

We have already seen that, assuming simple capital and homogeneous income, an invention or windfall, positive or negative, will produce one complete oscillation in the rate of interest, i.e. the rate of interest moves to either side of the downward trending rate that is associated with normal equilibrium-development. The four types of case we have distinguished may be represented as follows :—

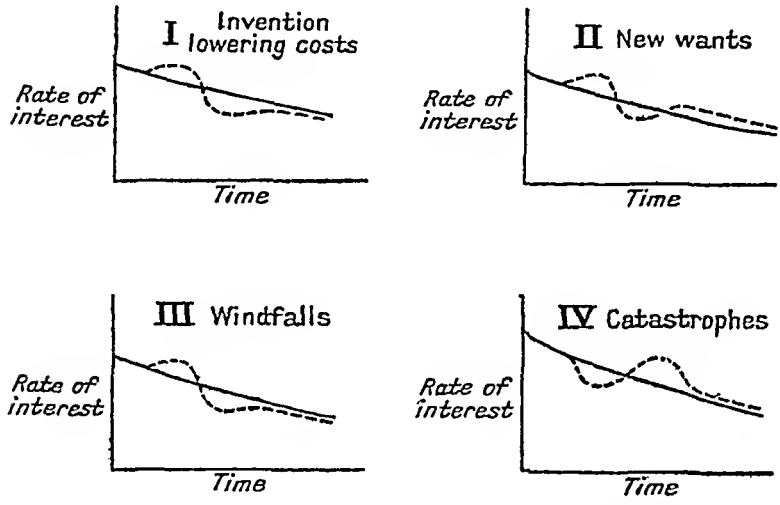

FIG. 5.—Effect of " accidents " on the rate of interest. The developmental trend of the rate of interest is given by the continuous line in each case. The modification of this trend by the four principal kinds of " accident" is given by the dotted line in each case.

Cases I, III, IV, must fulfil the condition that the product of the new rates of interest (over the whole period until the rate becomes unity) should equal the product of the old rates, but Case II requires that the product of the new rates is greater than the product of the old. This follows from the fact that in cases I,[1] III, IV, the stationary

[1] Unless the invention introduces a more productive method than even the longest method previously known, in which case the stationary state will be different.

state to which development proceeds is unchanged; and whether development is rapid or slow, the product of all interest rates remains unchanged. But Case II implies a new stationary state, with a larger income, and therefore the product of interest rates is raised.

The oscillation of the rate of interest implies also an oscillation in the rate of saving, or, what amounts to the same thing, an oscillation temporarily distorting the otherwise steady progression in the time structure of production, and, in addition, a minor oscillation in the amount and value of labour, and some oscillation in the amount of income. If, owing to the economic organization, any of these appropriate oscillations are prevented from appearing in their appropriate form and magnitude, a dis-equilibrium occurs, in which the oscillation of the rate of interest is magnified (or in special cases prevented from exhibiting its appropriate magnitude), values of capital are distorted through an insufficient oscillation of the time structure of production and the rate of saving, excessive unemployment or over-employment with an inappropriate oscillation in the value of labour take the place of an appropriate oscillation of employment and wages, and the oscillation in the amount of income is exaggerated. In particular, if an unneutral elastic monetary system, subject to banking principles, is in use, the amplitude of these oscillations is certain to be exaggerated and the oscillation to be repeated, giving us the characteristic features of a simple form of the trade-cycle.

If we are dealing only with inventions and windfalls affecting particular individual constituents of real income, then if these are of sufficient magnitude to affect future rates of interest, the main oscillatory effects would be shown in the behaviour of the rest of the system.

We have seen that inventions and positive windfalls, as disturbing factors affecting the smooth developmental

interest trend, lead first to a relatively sharp upward movement in the rate of interest, followed by a downward movement to a lower rate than development without the invention or windfall would have given, followed by a recovery towards this rate. (A negative windfall, on the other hand, causes an oscillation which is similar but of opposite phase.) It is usually assumed that this rise in the rate of interest is appropriately associated with an increased rate of saving, at least in the case of new inventions. There is, so it is assumed, an increased demand for capital, and therefore a rise in its price, given by the new equilibrium position of demand and supply. The confusion involved in this method of analysis should now be apparent. An increased demand for certain kinds of capital goods is not an increased demand for saving. It is just as compatible with a decreased demand for saving, since it is essentially an increased impatience for a particular kind of wealth (because of its productiveness) so that the previous equilibrium with resources smoothly flowing into the appropriate capitalistic methods is disturbed, and future income is sacrificed by the diversion of resources into the channels in which they are now more urgently required. Therefore, in the great majority of cases, the rate of (future) saving will actually be diminished and may easily become negative ; and only if the invention is the invention of a more roundabout method of production covering a fair range of industry may we expect the rate of saving to be increased. As regards the creation of new (net additional) wants, saving will in all cases be diminished ; while foreseen windfalls may increase or decrease saving, according to the degree of capitalism in the industry directly affected and according to the windfall commodity's elasticity of substitution for other commodities. A negative foreseen windfall, on the other hand, will raise the rate of saving, unless the degree of capitalism in the industry directly affected and its elasticity of

substitution over and against other commodities demands some net withdrawal of resources, from longer to shorter methods.

If all production were by "Simple Capital" methods, appropriate adjustment could come about without waste of wealth, but the existence of working capital and fixed capital in actual fact reduces the flexibility of the system and may lead to an apparent waste of wealth in the guise of failure to complete the application of labour to working capital (with the result that it deteriorates, or is held as an unnecessary stock) or failure fully to utilize fixed capital (so that it remains idle).

The next phase, in all cases but that of negative windfalls, is that of falling interest, recovery in the rate of saving, and, in general, movement to a peak rate of saving. During this phase the accelerated industries reduce their rate of expansion, while other industries which have moved to shorter methods abandon these again in favour of the longer methods (or, in so far as rigidities have led to idleness of capital, recover some of their previous activity) as the gap in future income, brought about by the temporary resort to shorter methods, is made good.

Finally, the rate of interest rises for the last time, while industries are moving towards their proper new developmental balance. This is then followed by a renewal of normal development to more and more roundabout methods with a falling rate of interest and a diminishing rate of investment, with, in general, a diminishing rate of saving.

The fluctuation we have been dealing with may be described as an "equilibrium-fluctuation" in precisely the same sense as development, according to our equations, is equilibrium-development. Given the invention or windfall, the equilibrium-fluctuation is determined in precisely the same way as is development on the assumption of no

unforeseen accidents. Given a distribution of accidents through time and given the points of time at which they are foreseen, and assuming that all decisions are made on the basis that what is not foreseen does not exist,[1] then equilibrium-development is one of gradual decline of labour, rise of income, increase of capital, fall in the rate of interest, and fall in the rate of investment (and, in general, of saving), interspersed with fluctuations which, whenever a foreseen accident is of sufficient magnitude to affect future rates of interest appreciably, is visible as a complete oscillation in the rate of interest and the structure of production, in the rate of saving, in the amount of labour, and in the amount of income. This fluctuation is, of course, the most economical response to the situation, just as general equilibrium-development is the most economical response to the facts of aversion from work, desire for income, and scarcity of land. But there is a retardation of development resulting from inheritance and land-ownership and this is increased still further owing to that cost of discovering what equilibrium requires, which manifests itself in the form of entrepreneur profit or in the salaries of collectivist planners. Therefore, inventions and windfalls produce fluctuations of inappropriate magnitude and form, owing to the enhanced difficulty with which entrepreneurs are faced in finding an appropriate response in a situation complicated by these accidents. There will be a delay of adjustment, similar to the delay of development, and as a result, not only will the fluctuation be magnified, but it will have some slight tendency to become oscillatory, just as any system which has inertia and is made to fluctuate once will only come to rest after a series of diminishing oscillations. The importance of this fact

[1] Decisions are, as a matter of fact, influenced to a considerable degree by estimates of risk. The existence of such estimates means that fixed capital in particular will not be produced as freely as pure equilibrium development would dictate—with results in some cases beneficial, in some cases the reverse.

can only be appreciated after we have assessed the influence of monetary systems on developmental equilibrium; and its consideration will therefore be postponed until we have investigated what is required of a monetary system in order that it should be neutral in its effects on development.

Chapter IX

NEUTRAL MONEY IN A NON-CONTRACTUAL WORLD

Underlying the conception of equilibrium-development is the assumption that wealth can be exchanged without cost, and that all exchange of wealth for wealth or for labour takes place in a perfect market. Money, therefore, is implied; since exchange with any approximation to costlessness is obviously impossible without a medium of exchange. The conditions that money must fulfil in order that it shall not disturb the course of equilibrium-development is the subject of the present chapter. If money is also used as a standard of deferred values for the purpose of contracts, the conditions for neutrality,[1] in so far as neutrality is

[1] There is no doubt a sense in which new wants or new inventions (which may be described as desires to produce things in new ways) resemble changes in the desire to hold more or less money. All alike are disturbing influences breaking in upon the even tenor of smooth development and causing undeserved suffering in unexpected directions. A certain type of despotic government with a really materialistic view of human happiness might be pictured as using all its strength to prevent such disturbing influences. But the individualistic background to the thoughts even of the most communistic types is repelled by the idea of such interferences except when the disturbances appear to be catastrophically dangerous. Money, however, appears to stand on a different footing. It is a definite creation of the State or at least of the community. It is maintained by the State. It has always been freely modified by the State; and the disturbing influences of those who attempt to issue additional counterfeit money (reducing its value) or to cling to money (enhancing its value) can produce widespread dislocations affecting the lives of all to an extent far greater (at least in the short run) than those who invent new ways of transport or new types of recreation. Hence it is not unreasonable to proceed on the assumption that new inventions and the emergence of new wants should be treated like changes in the weather, to which human beings must adjust themselves as best they can; while monetary disturbances, resembling the wilful acts of human beings who deliberately disturb the peace on inadequate grounds, fall naturally within those classes of actions that the State (evolved for the promoting of the good life of its members) has as its proper sphere of action (if they do not, in fact, constitute the sole justification for the State's existence).

possible, are more complex and will be investigated in the following chapter.

Let us assume, for convenience, that money is a commodity which can be created without cost. Then in a non-contractual world (i.e. a world in which no contracts through time are made in terms of money), neutrality can be achieved if certain conditions are fulfilled.

Let us first take the simple case in which there are no changes of relative demands for money on the part of members of the community, a situation which is possible with a stationary population, if we neglect the changes in personnel. Neutrality is preserved if the quantity of money is kept constant; or, with a varying amount of money, if the increments of money are handed freely to all members of the community in proportion to their demands (i.e. desires for an average holding) or decrements removed for destruction in proportion to demands.

In the more likely case of changes occurring in relative demands for money on the part of different individuals or groups within a community, then precise neutrality is preserved with a constant quantity of money, only if money is removed from those whose demands fall and handed over to those whose demands rise, so that when the redistribution is effected demands are just satisfied and there is no tendency on the part of any member of the community to expand or contract his average holding. If the quantity of money is allowed to vary, then, in the case of an expansion of the quantity of money, increments would need to be handed over freely to those whose demands have relatively increased and smaller increments (in some

We have therefore been deliberately excluding these new wants with regard to money from the category of new wants and inventions on the ground that anything that can be called an appropriate adaptation to these monetary desires is a matter for legislative action of the State (despotic interference), and does not fall within the sphere of mutual economic adjustments, which constitutes the sphere of economics proper. [For this footnote I am indebted to Mr. Alston.]

cases, negative increments) to those whose demands have relatively decreased. In the case of a contraction of the quantity of money, larger decrements would, similarly, need to be removed from some members than from others (and these decrements might, in some cases, be negative). Provided the money, new and old, is redistributed in such a way that, after the redistribution, there is no tendency on the part of any member of the community to make any change in the size of his new average holding, precise neutrality will have been achieved.

While precise neutrality could only be achieved even in a non-contractual world, on the above entirely fanciful plan, whether we keep the quantity of money constant or allow it to vary, it is nevertheless possible to achieve approximate neutrality without resort to practical impossibilities. If the quantity of money is kept constant approximate neutrality is achieved, without the necessity of any redistribution of the stock of money; while, if the quantity of money is allowed to vary, approximate neutrality is obtainable, provided that the quantity of money in the possession of each member of the community is allowed to vary[1] (by amounts, per unit of time, that are small in relation to the amount held) in precise proportion to the amount he is at the moment holding (as if the denominator of every piece of money in each person's possession were at each moment of variation, multiplied by some given figure).[2]

[1] We shall revert to this point, in what may be called an etherealized form, when we attempt later to construct and formulate a policy to counteract those disturbing influences due to the actual non-neutrality of money.

[2] If money were varied suddenly on this plan, the approximate neutrality would, of course, be less than if the variation were gradual and continuous. An average holding of money implies that, at any moment of time, some persons are holding less than their particular average and others more, so that a change in the quantity of money in proportion to momentary actual holdings will give different results from a change (involving the same total change in the quantity of money) in proportion to average holdings (i.e. in proportion to relative demands), with the attendant obvious injustices that this, incidentally, would involve. A gradual and continuous change in the quantity of money in proportion to each person's

To elucidate this further, let us see what happens if the quantity of money remains constant. If relative demands for money remain unchanged, then aggregate prices rise or fall according as aggregate demand for money falls or rises; but this gives rise to no change in anyone's consumption or purchase of capital. The community has simply decided to value its money more or less highly than before,[1] and this gives rise to no economic consequences whatever in a non-contractual world.

Next, let us assume that there is a change in relative demands for money, while the quantity of money remains constant. An automatic redistribution of this stock takes place, those whose demands for money have relatively fallen parting with money, those whose demands have relatively risen parting with goods. The former go without money and acquire goods, the latter go without goods and acquire money. Let us call the latter process of "going without goods" "lacking",[2] and the former process of "going without money" "dis-lacking"; then the change in relative demands for money induces an amount of "lacking" and an amount of "dis-lacking", exactly equal to one another, at every moment in the transition to the new equilibrium, until the redistribution is fully established, and "lacking" and "dis-lacking" have come to an end. (It should be unnecessary to repeat that every purchase or sale involves a momentary dis-lacking or lacking). During this movement to a new monetary equilibrium, aggregate prices may remain unchanged, rise, or fall (the

actual holding at each moment, will, of course, be the same thing as a change in the quantity of money over the whole period in proportion to each person's *average* holding (i.e. relative demand) over that period. It is only a gradual and continuous change in the quantity of money on this plan that would be both approximately neutral and a practical possibility.

[1] See Alston, *Functions of Money*, pp. 69 seq., for an elucidation and illustration of this point.

[2] I must apologize to Mr. Robertson for using these terms with new definitions, but I wish to suggest later that the analysis in *Banking Policy and the Price Level* requires the definitions I have given.

precise result depending upon the extent to which there is any change in what might be loosely called the general attitude to money).

In this process of readjustment, there is no guarantee that those who part with money will want the same goods as those who acquire money wish to part with. If this did happen to be the case, then money and goods would simply change hands; there would be no changes in relative prices, and prices as a whole would remain unchanged, rise, or fall, and the neutrality of money would be preserved. But to the extent to which those who "lack" do not wish to part with the actual goods which those who "dis-lack" prefer to acquire, there will be some dispersal of prices between different goods required for income, and possibly also between income goods and capital goods. To the extent to which prices are thus dispersed (and not through changing relative values), money is unneutral, and the departure from neutrality is given by these changes in relative prices, whether the total money-value of goods remains constant, rises, or falls.

If there should be no difference, as between lackers and dis-lackers, in relative demands for income goods as compared with capital goods, then we may say that money remains neutral between these two groups, each taken as a whole (for the total value of a total of goods can remain unchanged, however much the relative values of constituents of the total may change). But the preference-schedule for income as compared with capital of those who lack might conceivably differ from the preference-schedule of those who dis-lack, and as a consequence there might be a change in the total price of income-goods, over against the total price of capital goods, whether or not the total money-value of all goods remains constant, rises, or falls. Whenever the total money-value of any group of goods rises relatively to that of any other group we like to select, as a result of lacking and dis-lacking, whether or not it rises or falls

absolutely, we shall speak of an " inflation " of the former or " deflation " of the latter. If the money-value of capital as a whole rises relatively to that of income goods as a result of lacking and dis-lacking, whether prices as a whole are rising or falling, we shall speak of a " capital inflation " (with, of course, a correlative " income deflation ", and for this in future we shall use Keynes's phrase " commodity deflation " as a convenient synonym) ; and if the money-value of capital as a whole falls relatively to that of income goods, as a result of " lacking " (and its correlative dis-lacking), we shall speak of " capital deflation ", whether the price-level [1] as a whole is rising or falling.

It seems clear that a change in relative demands for money will not, in a non-contractual world, be associated with a different bias towards capital on the part of the lackers from that of the dis-lackers ; for the changes in demand will be, on the whole, merely the consequences of changes in the technical conditions of exchange, since the demand for money in such a world must solely be a demand for exchange-convenience (it being the background of contract in the actual world that causes the familiar changes in outlook to express themselves in monetary hoarding or dis-hoarding). Those who find themselves impelled to build up larger average money-holdings will have no more reason to give up capital rather than income than have those who contract their average money-holdings to acquire capital rather than income. There is no reason to expect capital inflation or deflation, whatever inflations or deflations of particular goods there may be ; and there is no reason to suppose that these inflations and deflations will be more than trifling disturbances of static equilibrium. We may, therefore,

[1] It is perhaps wiser to speak of a total money-value, because the term price-level has also been used to refer to some kind of average of prices of a number of goods, which may change their nature and their proportions. Price-level, as I am using it, has a perfectly precise meaning. An average price-level, though useful for certain practical purposes, seems to have no place in pure theory.

assume that a constant quantity of money will preserve approximate neutrality as between capital and income, whatever the effect on the price-level as a whole ; and equally a variable quantity of money, provided it is handed out to or abstracted from every member of the community in proportion to his money-holding (if the changes in the quantity of money are gradual and continuous), since no further lacking or dislacking is brought about by the creation or destruction of money, when carried out in this way.

Since no device can be imagined for handing out new money to those whose demands for money happen to increase relatively to others, or for abstracting it from those whose demands happen to fall relatively to others, we reach the important conclusion that it is of the nature of money to be unneutral, even in a non-contractual world. Nevertheless, approximate neutrality can be achieved, provided we keep the quantity of money constant. But in a contractual world, the movements of prices if money is kept constant in amount are likely, as we shall see, to cause even greater unneutrality, so that in practice we find stabilization policies intended to counteract the unneutrality that is a consequence of the existence of contract at the expense of increasing the unneutrality that could exist without contract. But we have also shown that approximate neutrality could be preserved in a non-contractual world with a varying quantity of money, provided only that money is handed out to or abstracted from everyone (the increments at each successive moment being small) in proportion to the actual money-holdings (at each successive moment), and, therefore, we can have any price-level (total price of all goods) we like. Since, as will be shown in a later chapter, it is possible to manipulate money so as to produce results equivalent to those that would be attained by varying the quantity of money on this plan, there is no need in the real world of contract to sacrifice the approximate neutrality

which we have shown to be obtainable. Since banking implies variation in the quantity of money on a different principle, money is necessarily unneutral when bank-money is the principal medium of exchange, and the attempt to overcome the unneutrality by any price-stabilization policy in a developing community is doomed to fail.

We have assumed that in a non-contractual world the demand for money is solely the demand for exchange-convenience. If, for any reason, money were demanded beyond this point as a substitute for the holding of capital, (i.e. were " hoarded " in the popular [1] sense of that word), there is no reason to expect neutrality to be preserved; for hoards would tend to be built up by the richer members of the community at the expense of the poorer, and, while the hoarders would tend to lack capital and income in appropriate proportions for them while building up their hoards, the dis-lacking of the poor would be concerned almost exclusively with income. There would, therefore, be a tendency to relative capital deflation, while hoarding is on the increase, and a tendency to capital inflation while hoarding is on the decrease. It would seem, at first glance, that hoarding might occur in a non-contractual world; for individuals are not actuated merely by the desire to distribute their labour and income most economically through time, but also to hold their wealth in liquid form. If a person had to take charge of his capital in any way which involved him in trouble or specialized risk, he might be prepared to sacrifice the advantage of drawing interest and hold money instead of capital. But capital can be owned without there being, in fact, any serious disadvantage from illiquidity in the form of shares in joint-stock companies, and, what is more important, in the form of shares

[1] All holding of money for exchange-convenience amounts, in ultimate analysis, to short-period hoarding; while the most obvious forms of hoarding are ultimately for future exchange-convenience.

in investment companies, which, as it were, generalize the capital held and, therefore, the risk. Furthermore, there is a way of holding capital which is extremely close in appearance to holding money, namely by holding time-deposits at interest, provided the bank or savings bank which provides this opportunity conducts its business on some such principles as these.[1]

It would need to be a savings bank rather than a bank in the customary English meaning of the word, and would also differ from an ordinary investment company. The deposits of such a bank would be, in one sense, the equivalent of the shares of an investment company and deposit interest the equivalent of dividends. An individual " withdraws his capital " from an investment company by selling his shares at the market price, but from a true savings bank he withdraws a deposit that always has the same money-value. For our purposes a savings bank would need to be a monopolistic state institution, since the withdrawal of a deposit (unlike the sale of an investment trust's share) involves a reduction of the resources under the savings banks' control, and if there were competitive savings banks the less successful would collapse by the movement of resources to those that, being more successful, were paying higher dividends (i.e. deposit-rates). The whole of the capital of such a savings bank would be subscribed by the depositors with the credit of the state behind it.

As it will later be suggested that (apart from the mere provision of convenient modes of transferring the ownership of money from one depositor to another) the only kind of banking activity compatible with a neutral money is savings banking on the above plan, let us see how such an institution would behave. Its purpose, as we have seen, is to allow individuals to satisfy their desire for liquidity

[1] For a similar treatment compare Alston on this question " Aspects of the English Currency System," *Economic Journal*, June, 1932.

without this taking the form of a holding of money in excess of the requirements of exchange-convenience. The individual is dissuaded from hoarding by being afforded savings-deposits, which yield a variable deposit interest and are convertible into cash-deposits or, in other words, can be withdrawn as cash whenever the individual so desires. The balance-sheet of such a bank would be comparatively simple, for " liabilities " would consist of " deposits " and " profit and loss " (the latter falling to zero whenever deposit-interest is paid), while " assets " would consist of " investments " and " dividends from investments " (the latter item disappearing whenever deposit interest is paid). As deposits are withdrawn, so investments are sold, and as deposits are purchased, so investments are bought.[1] The purchases or sales of capital by the bank are never inflationary or deflationary of capital in general over against income in general, since the withdrawal of a deposit would mean that the depositor's wishes were being fulfilled and his purchases would counteract the deflationary effects of the consequent sales. The real savings intentions of the public are thus being carried out; in other words a demand for money for purposes other than exchange-convenience is prevented from arising and the neutrality of money as between capital and income is preserved. It will be suggested later that a state bank providing deposit-accounts on this plan and paying a deposit-rate of interest could furnish a monetary system which would remove the two inevitable evils of true banking systems, the elasticity of credit and the elasticity of hoarding.

We may conclude, therefore, that in view of actual and

[1] We are not here concerned with the fact that under existing monetary conditions a savings bank, even if it had no cost of operation (which we are virtually assuming), would be bankrupt at a certain stage of the trade-cycle, when, owing to a general fall in capital values and reduction of dividends from many investments, deposit interest would tend towards zero and even below, while attempts were being made to convert all deposits into cash for hoarding.

possible arrangements, there is no reason why money should be hoarded in a non-contractual world, and, therefore, our conclusion holds that approximate neutrality of money is possible in such a world and with any price-level or movements of price-level [1] which may be desired.

In the above analysis we have said nothing about saving; but, from the individual's point of view, there is a sense in which the process of lacking, if this term were confined (as Robertson confines it) to the dispensing with income-goods, is a process of saving.[2] The associated dis-lacking must be similarly, to the same extent for another individual, described as a process of dis-saving sufficient to neutralize the saving. In other words no redistribution of a stock of goods and money can itself be a process of saving or dis-saving from the point of view of the community, although it may lead eventually to a change in the rate of saving. Real Saving from the community's point of view at the moment of its initiation by an act of investment is always a postponement of future income to a more remote future

[1] i.e. total price of goods, or total price of any one group of goods, but not, of course, of more than one group, unless their prices happen to move together.

[2] As will be made clear in a moment, the term lacking and the term saving (in the sense in which it has been used earlier in this book) are not on the same footing since there is no such thing as saving at a point of time; for saving and investing are processes extending over a period of time and containing a reference to time that is part of their essence. Lacking on the other hand (i.e. the acquisition of money), though taking place alternately with dis-lacking whenever a sale or purchase is made, and whether the individual or group we are considering is moving in the direction of greater lacking or greater dis-lacking, could take place as the result of a simultaneous complete decision of all the parties concerned. Time, in other words, though a necessary accompaniment, is not of the essence of lacking. When an individual lacks by parting with income goods, he may, however, be said to "save" (although this is neither an amount of saving nor a rate of saving in the senses in which we defined these terms in Chapter III). "Saving" in this sense (saving from the individual point of view, as we might call it) is a parallel term to lacking, and the total "saving" and the total lacking that takes place in a community, in moving from one point of time to another, are always zero, provided that when the quantity of money changes the money created or destroyed is still regarded as being held somewhere (e.g. deposits not yet created by the banking system must be regarded as being hoarded by the banking system).

(unless there exist cases where absolutely " non-capitalistic " production is yielding income). An exchange economy makes it possible for an individual, however indirectly and capitalistically he obtains his income, to postpone his present income to the future or to anticipate his future income in the present; but in so far as he does this it must always be by inducing someone else to do the opposite. If he makes no change in his money-holding, he " saves " by bartering income for capital, and this means that someone else has parted with capital for income and " dis-saves " to an equal extent. In other words, the saving from the community's point of view that is taking place as an outcome of decisions which are always in the past can be redistributed among the members of the community as they will. But if the desire to " save " more on the part of some members of the community is not perfectly balanced by the desire on the part of others to " save " less, then the value of capital in terms of income changes until equilibrium is achieved. There is a capital inflation or deflation which will influence in various ways the decisions of the community with regard to the commitment of resources (i.e. investment), so as to alter the time distribution of future incomes, and, therefore, the future rate of saving; but the present rate of saving is, of course, unaltered. If, on the other hand, a person alters the amount of his money-holdings, he must alter the amount of his income or his capital or both. If he decides to hoard more money, his lacking may be a lacking of capital, in which case there is no change in his " saving ", or it may be a lacking of income, in which case his " saving " is increased by the amount of his lacking.

Let us now break into a moment of equilibrium-development and take a period of time sufficiently short for it to be permissible to regard the structure of production as remaining unchanged. Then over this period there is a certain total of real saving being performed. This total

real saving can be redistributed amongst the members of the community in any way they wish through mutual exchanges of capital and income. These exchanges might be effected without any change in the relative value of capital as a whole over against income as a whole; but if, for any reason, the community's net bias towards income has changed, then the process of redistribution leads to a capital inflation (a rise in the total value of capital in terms of income) if the bias is in favour of less income (a frustrated attempt to save more); or it tends to a capital deflation if the bias is in favour of more income (a frustrated attempt to save less); for every individual will have succeeded in capturing his share of the unchanged total of real saving, and the new relative prices will register the new equilibrium.

This could conceivably happen with no redistribution of monetary holdings (money behaving in a perfectly neutral manner, just as if the exchanges were effected by magically efficient barter). But there may also be changes in monetary holdings, without involving anything more than a redistribution of the community's saving, and without involving any changes in relative values. This redistribution may, on the other hand, be associated with a bias, as regards the relative attractiveness of capital and income, on the part of the lackers that differs from the bias of the dis-lackers, in which case there is capital inflation or deflation. An inflation or deflation thus brought about is the result of the unneutral behaviour of money, and is analytically distinct from the capital inflation or deflation that results from non-monetary occurrences, such as a new invention, or a windfall.

Ignoring these non-monetary influences, let us pursue further the consequences of a "monetary" influence on the lines adopted by Robertson,[1] remembering that Robertson's

[1] Robertson, *Banking Policy and the Price Level.*

term "lacking" is what I have called "saving" (from the individual point of view) and that I mean by "lacking" "going without goods", and, therefore, "acquiring more money." Since we are dealing with a period of time which we can make as short as we please, we shall mean by "lacking" the process of "acquiring more money", and by "saving" the process of "going without more income". An "increase of hoarding" is "lacking", not an "increase of lacking", since lacking denotes the acquisition and not the retention of money. The total of lacking and the total of "saving" are, therefore, necessarily zero.

Let us suppose, in the absence of any creation of new money, that some persons increase their hoarding. We may call this "spontaneous lacking". It may or may not be "spontaneous saving", for the goods parted with may be capital or income in any proportions. But it is clear that the "spontaneous lacking", with whatever degree of "spontaneous saving" it may be accompanied, occurs only to the extent that other persons part with money for goods and thus suffer "induced dis-lacking" (with an amount of "dis-saving" equal to the "spontaneous saving" of the hoarders). There is no moment at which the other holders of money obtain the advantage of goods at a lower price without parting with their money.[1] There is no "automatic dis-lacking" or "automatic dis-saving", other than the "induced dis-lacking" or "induced dis-saving" involved in their parting with money in order to hold the appropriate amount of it. The money does not disappear into the void before passing into the hands of the hoarders so as to bring down prices and enable others

[1] Robertson speaks of "money sitting" and "money on the wing". As Alston has pointed out, all money is always sitting (i.e. is always in somebody's ownership). No money is ever "on the wing" (i.e. passing from one ownership to another). Robertson has neglected to warn his readers not to press the analogy too far.

to obtain with their labour a greater quantity of goods (whether income goods or capital goods) so that they automatically dis-lack or dis-save ("splash" or "dis-lack" in Robertson's terminology) and, in the course of incurring their customary expenditure subsequently finding they have too much money, undergo a further process of induced dis-lacking or "dis-saving" by parting with yet more money until they again find themselves with the amount they consider appropriate to the new price-level. On the contrary, the whole process is one simultaneous process of readjustment, whereby some holders of money acquire more money by parting with goods and others part with money in acquiring these goods. Thus the distinction between "spontaneous" and "induced" is much more tenuous than appears at first sight.[1] There may, of course, be cases in which the process is unmistakably initiated by the consciously changed attitude of some persons, others being relatively passive. In such cases, when those who are thus desirous of building up their money stocks are beginning to acquire any additional money, they still find their stock of money too small, and are induced to acquire yet further money, while those who are parting with money find in the gradually changing price-level a ground for thinking that even their reduced money-holdings are now too great and are induced to part with yet more money. Thus the relative spontaneity of the hoarders, others being relatively passive, merely expresses the state of conscious dis-equilibrium of the hoarders as long as the passivity of the others fails to produce equilibrium by yielding; whereas the rest of the community previously feeling themselves in a state of

[1] It is similar to what happens either in a barter society or a money-using community, when group A becomes keener on having clothes in comparison with wheat and drives up the relative price of the former. Group B, whose relative demand schedules are unaltered, takes more of the income in wheat and less in clothes, its holdings (or its consumption) becoming adjusted to different points on an unchanged indifference curve.

equilibrium are continuously becoming conscious of a trifling dis-equilibrium continuously being corrected until the initiators of the movement come to feel that no dis-equilibrium on their side remains.

Let us now assume—what Robertson appears to take for granted—that the hoarders, when lacking, are also "saving", while the rest of the community has not changed its attitude; then, as a consequence of this, "dis-saving" is being forced on the rest of the community by the agency of a relative capital inflation. Not only are those affected who in parting with money to the hoarders undergo induced dis-lacking, but also those who, while making no change in their money-holdings at first, will, because their attitude to capital and income remains unchanged, part with capital, the income-value of which is raised, for income, and thus can be said automatically to splash. Since this "automatic splashing" is the result of the capital inflation (commodity-deflation), it is important to distinguish it from the induced dis-lacking, which, while necessarily equal to the spontaneous lacking of the hoarders, does not necessarily mean that those who are performing the dis-lacking are doing an amount of "dis-saving" equal to the "saving" of the hoarders, since part of the "dis-saving" may be performed by the automatic splashers who are not necessarily at the same time dis-lacking.

In a society which suffers from the consequences of changes in the quantity of money, not acquired (or lost) by its members in proportion to their individual holdings, Robertson's analytic method becomes most illuminating, if we treat the "quantity of money" as constant at an indefinitely high figure, the banking system being regarded as an indefinitely great hoarder inspired in its behaviour by some form or other of "banking policy". Since the banking system when it spontaneously hoards or dis-hoards (and therefore lacks or dis-lacks) can perform no "saving" or "dis-saving" whatever, it necessarily produces a

capital deflation or inflation whenever it destroys or creates money. This comes about through the induced dis-lacking or lacking of the community which, since it is likely to be associated indirectly with some degree of individual " saving " or its opposite, may stimulate some automatic stinting or splashing, so as to preserve the total of " saving " at zero.

We have now confirmed the conclusion that in a non-contractual world the only appreciable departure of money from neutrality is likely to come about from variation in its quantity. In the actual world we naturally think of this as coming about as the result of banking action, and it is convenient to think of it in this way, in spite of the difficulties of conceiving in such a non-contractual world of a banking system, which would, *ex hypothesi*, make no loans but only buy or sell capital. Variations in the quantity of money produced in this way inevitably lead to capital inflation or deflation, except in so far as the variations accidentally compensate for any variations of individual hoarding, that do not replace purchases or sales of capital and thus do not represent individual " saving " (since, if these were the only cases, the banking system might be said to be acting as a savings bank rather than as a bank). In addition to this unneutrality as between capital in general and income in general, money is made unneutral as between different kinds of income goods and as between different kinds of capital goods. This follows from the fact that the dis-lacking (in the case of credit creation [1]) of the banking system is accompanied by no " dis-saving " on its part, so that there is an equal amount of induced lacking on the part of the public; but every individual attempts to distribute his lacking between capital and income

[1] The argument, in so far as it is concerned with our immediate purpose, would not be affected if credit creation were extended to cover not only the creation of bank money by the purchase of securities, but also the granting of short period loans.

instead of confining it to capital alone. Thus, the extent to which some happen to be "saving" as well as lacking is the extent to which others are necessarily "dis-saving" whether or not they lack. In other words, although the community is induced (rather than "forced") to part with capital to obtain the new money, only those with capital are able to obtain it. Thus a dis-equilibrium is set up between these holders of money and all holders of income goods; for those who sold capital may be expected to purchase some income goods with their increased money, and those who had no capital will be induced to effect a readjustment by parting with income goods. Unless either income were homogeneous or the income goods sold were perfectly representative of income goods in general, there would be a change in the relative prices of income goods of a different order from the comparatively trifling change in such prices which occurs as a result of changes in the relative demands for money (since in the latter case there will be no bias in favour of particular classes of goods, whereas in the former case there may well be a bias due to the fact that the purchasers of income goods are those who own capital, while the sellers of income goods are the relatively poor). There is, therefore, not only a capital inflation, but also some relative inflation of the values of income goods consumed by the rich and a relative deflation of the values of those consumed by the poor. But, again, let it be reiterated that this is a change of relative values and is consistent with any change in the price-level as a whole, though, if the only change is an increase of bank credit, there must, of course, be a rise in the total price of capital and a smaller rise in the total price of income goods, of which the smallest part, if any, would occur among goods consumed by the poor.

Let us now consider the implications of this analysis.

In so far as development is in equilibrium, capital and income are appropriately proportioned, and have appropriate values, future rates of interest being already determined or in process of being determined. This will be true whatever definition of equilibrium-development we adopt. (We can allow, if we please, for such things as normal inheritance, normal changes in population, and what we might call a normal entrepreneur profit; and, whatever we include, the values of capital and income and rates of interest will be normal, in the sense of being appropriate in the environment that we have decided to regard as normal.) Now, if development is normal, the income-value of capital is rising [1] and the rate of interest is falling, so that in one sense of that word capital inflation must be regarded as normal; but it will be convenient to use the term capital inflation to refer rather to a rise in the income-value of capital greater than this, and capital deflation for a rise in income-value less than this (the term "rise" covering, obviously, in certain cases an absolute fall).

The normal rise in the value of capital thus expresses the increase in future income, the changing structure of production, and a rate of interest greater than unity (or greater than the "mean" rate of discount, if the future is effectively discounted); for the absence of such a rise would mean a constant future income, an unchanging structure of production, and a rate of interest of unity (or equal to the "mean" rate of discount, if the future is effectively discounted). Quite apart from monetary influences, a capital inflation or deflation as distinct from this normal change in values can come about as a result of some "abnormal" influence, such as a new invention or windfall, but only in so far as future income, the structure of production, and future rates of interest also move; though in the case of a

[1] i.e. capital n days from maturity (to take the case of simple capital) has a higher income-value than precisely similar capital n days from maturity on an earlier day.

foreseen windfall or a change in wants (it may be noted again) rates of interest and the value of capital can change before there is any change in income or the structure of production, since the marginal utility of present income is altered, either because there is a change in the amount of it or because it is wanted more urgently. The movement of future rates of interest thus takes place simultaneously with the capital inflation, and is rather another aspect of it than its effect or its cause ; for even in the case of an invention of a new method of production, as soon as there is any change in the structure of production there is a change in the amount and distribution of income through time, and it is this which is reflected in the rate of interest and the change in the value of capital. It may be suggested that, before the structure of production begins to change, the invention of a new method of production will give rise to changes in values, and it is, of course, true that the values of particular capitals that are rendered obsolete will fall, while other kinds of capital compensatingly rise ; for the consequent redistribution of wealth is unlikely to alter the general bias in favour of capital over against income. There will, therefore, be no capital inflation or deflation. Only when the new method begins to be adopted do we get a change in the structure of production, a change in future rates of interest, and the appropriate capital inflation or deflation. But in the case of a windfall or of the invention of a new want, the capital inflation or deflation is an immediate response to the occurrence of the windfall or the emergence of the want ; since, in these cases, the attempt to buy more (or less) income shows a bias on the part of the whole community in one direction, and rates of interest move simultaneously before there is any response by producers in the form of a change in the structure of production, though such a change quickly follows and leads to a change in the distribution of income through time.

We may conclude, therefore, that a capital inflation thus produced is simply a fall in future rates of interest as compared with what they would have been but for the abnormal influence, and the change is either introduced by or introduces a change in the general structure of production in the direction of the adoption of longer methods; and the converse is true of a capital deflation. Since the rates of interest are natural (not contractual), we may substitute for "capital inflation" the phrase "fall in the natural rate of interest" and the converse in the case of "capital deflation".

If we mean by the "natural rate of interest" the future rates of interest which are relevant to the situation under discussion, then any abnormal non-monetary influence tends to produce some change in the natural rate of interest (the relative values of the incomes of different future periods). Now in what respect does a monetary influence act in any different way? Clearly, it resembles the influence of a windfall or a new want, in that changes in the structure of production and distribution of income through time follow the change in the value of capital (the movement of the rate of interest).

Let us, then, confine the term "natural rate of interest" to that which would occur in the absence of monetary influences. Then if the "natural rate of interest" rises as a result of an abnormal non-monetary influence, and the banking system fails to check any increase of credit by raising the price of loans (to slip for the moment into a contractual world) or by selling securities, the rise in the rate of interest is checked and can be said to be below the "natural rate". In other words, whenever, owing to a rise in the natural rate of interest, due to a new invention or a new want or a positive windfall or to arrival at the last phase of fluctuation after a negative windfall (see Ch. VII), the banking system responds by expanding credit—and this is the most usual

response of most banking systems—it holds the actual rate of interest below the natural rate.[1] And, whenever, owing to a negative windfall or to arrival at the last phase of fluctuation from a new invention, a new want, or a positive windfall, it fails to prevent the contraction of credit, by lowering the price of loans or buying securities, it holds the rate of interest above the natural rate. The unneutral effect of the banking system is thus its tendency to stabilize the " rate of interest ", when the natural rate tends to oscillate. In addition, of course, there is the tendency, when development would otherwise be normal, for the banking system to force the rate of interest below the natural rate, since banking systems may in general be expected to favour or, at least, to allow themselves to become involved in a general expansion of credit.

If it be urged that it is the business of a banking system to correct any divergences between the actual and the natural rate of interest, involving what has sometimes been called a disparity between saving and investment, it would only be possible for the banks to achieve this by adopting what may be called the savings bank principle described on pp. 181–2, or, if we allow the granting of direct loans for business purposes, it would require the drawing up of an appropriate schedule of short-period rates and a readiness to modify them simultaneously even in opposite directions.

We have already seen that development in practice is necessarily slower than pure equilibrium-development, owing to the disturbances caused by the presence of such forces as inheritance and the scarcity of entrepreneurism. It might, therefore, seem possible to defend ordinary banking practice on the ground that it may happen in some measure to counteract these retarding forces and modify the

[1] This is not identical with the natural or normal rate as defined by Wicksell, *Lectures on Political Economy*, vol. ii, p. 192.

undesirable slowing down of development, and that banks behave rightly in holding the rate of interest below the natural rate so as to approximate to the rate that would rule under " pure " equilibrium-development. Since, however, the distribution of wealth would be affected, as well as the whole texture [1] of production, we have no means of knowing whether such accelerated development would be desirable, even if we ignore the nemesis that follows in the form of a distorted structure of production with its associated disturbances of future rates of interest—consequences that bring with them yet further distortions.

Whatever view we take of the advantages of accelerating development by banking policy in the absence of abnormal influences, there can be little doubt that the policy which attempts to smooth out the rate of interest when the natural rate, owing to non-monetary disturbances, fluctuates, is the strategical blunder out of which is born the credit cycle with its familiar evils.

Let us assume that the invention of a new method of production is of sufficient importance to raise the natural rate of interest, then the appropriate fluctuation can be regarded as a form of temporary borrowing, for investment in the new method, of resources set free elsewhere, in so far as such resources employed in the production of other constituents of income can be released by reversion of these industries to less roundabout methods. But if the banking system fails to adopt a restrictive credit policy, investment in the new method is allowed to exercise too vigorous a pull on resources, while at the same time the release of labour from other industries may well be retarded, with a consequent tendency for the total quantity of labour engaged in production to be inappropriately increased.

[1] Using the term " texture " for the kinds of capital, owing to the constitution of income, as contrasted with " structure " for the method of production from the point of view of its " capitalism " and " division of labour."

In a non-contractual world where there are no deceptive wage bargains this would be a matter of no great concern, since it would come about as the result of effective (though inappropriate) inducements, accompanied, however, by effective and, in this case, relatively appropriate checks; and when the next phase, the phase of falling natural rate of interest, should follow, the actual rate, almost inevitably held for a time above the new natural level, would restore the system to a new appropriate level of less labour and lower earnings, but higher earnings than at the beginning of the oscillation. But in a contractual world, as we shall see later, the increase of labour is not checked in this way, so that we have during a boom period excessive investment bringing with it excessive employment not only in the new methods of production but throughout industry, followed later by under-employment and the appearance of " excess capacity " in all industries. In the terminology of Keynes's *Treatise on Money*, investment has expanded in the first period so as to outrun saving. But the aggregate saving of the community, as we have been insisting throughout, cannot in the present in a developed capitalistic world be expanded or contracted to more than a trifling extent, except when the word " saving " is consciously used with special reference to the sacrifice of the potential near future income which occurs when additional labour is brought into play in the course of additional investment activity. This sacrifice is the only form that saving can take except in so far as some decapitalization of the structure of production is a possible alternative. Such disinvestment involves a readjustment as between future periods of the times of receipt of different amounts of income, and in this case, instead of saving in the ordinary sense, we have a sacrifice of more remote in favour of less remote income, a transfer of income through time that we have previously denoted by the word dis-saving. This readjustment is hindered

by the failure of the rate of interest to rise to what is, for the time being, the natural rate; and so the investment required by the new invention must come about by an increase in the amount of labour; and this is only possible in a contractual world if labour when offered a higher money wage assumes it to be a higher real wage, whereas the required result can only come about if the real wage is lower (as may readily happen in a contractual world).

A *particular* act of investment necessitates a readjustment of income. Such readjustment can take any or all of the following forms. There may be—

(*a*) A sacrifice of near future income in order to produce more remote income in its stead.

(*b*) An increase of labour unaccompanied by an increase of immediate income.

(*c*) A sacrifice of later income in order to produce earlier income in its stead (a transfer through time that we have called dis-saving in contrast to the transfer through time in the opposite direction, as in (*a*), that we have called saving).

But investment unaccompanied by disinvestment can only come about as a result of processes (*a*) and (*b*), i.e. by saving, since the dis-saving of future income by method (*c*), involving as it does the transfer of resources from longer to shorter methods of production, necessarily involves some disinvestment now.

In the absence of abnormal influences, investment proceeds in such a way that the community can be said to undergo no stinting, for saving is always at the expense of the fruits of increasing productivity due to the progressive adoption of lengthier methods. Saving is entirely by method (*a*). But an abnormal influence affecting investment can rarely

affect the amount of saving under this heading to more than a trifling extent. Therefore sharp changes in total investment under such an influence can only come about by the utilization of method (*b*). But this also can only be trifling. Consequently (owing to the impossibility of effecting serious changes in aggregate present income) labour must be induced to work harder without increase of income. The proper response to an abnormal influence is, therefore, to arrange that an increase of investment in one direction be offset by disinvestment in another direction ; and this involves that an appropriate amount of dis-saving by method (*c*) be combined with the requisite saving.

Now if an abnormal influence leads to investment in particular directions, the movement of the natural rate of interest would ensure the appropriate disinvestment and dis-saving, so that saving is not forced to come about by method (*b*). The banking system, by holding the rate of interest below the natural rate, checks this disinvestment and forces some adjustment by method (*b*), which is, unhappily, made even easier by the existence of contract and its associated non-plasticity of wages.

When, subsequently, investment by method (*b*) bears fruit, and the future income which would otherwise have been appropriately sacrificed, had the appropriate disinvestment by method (*c*) taken place, is in the present represented by a stock of capital which, as a stock, has been maintained at an inappropriately high level, then the natural rate is lower than would otherwise have been the case (owing to this undue provision for the future) and the actual rate is likely to be held above this new natural rate. Saving by postponement of future income to a still more remore future, is, thereby, checked ; dis-saving by producing more present income without changing the amount of labour is also frustrated by the capitalistic nature of practically all production, and, therefore, in a

contractual world the community is forced to dis-save, enjoying an unreduced present. income while unwillingly performing less labour. There is, therefore, a contraction in the use of labour, without a decrease of income, and this contraction is greater than the original expansion, owing to the fact that the natural rate of interest has been lowered further than would have been the case if the rate of interest had not been forced below the natural rate during the credit-expansion of the boom. (There is, in fact, no reason why the natural rate of interest should not be less than unity.)

It may also be pointed out that the boom that forms the first part of such a miniature trade cycle is likely to be comparatively short, though it may be apparently prolonged by a succession of inventions producing similar overlapping effects; but the subsequent depression is likely to be longer than the boom, owing to the exaggeration of the fall in the natural rate of interest and the difficulty of a banking system in making the appropriate response, even if such were its wish (especially as a negative rate of interest is, if called for, in practice impossible). But in the course of time the natural rate of interest must rise again as provision for the more remote future recovers. Such a recovery of the natural rate is a necessary feature of the revival of the process of building up the new structure of production that normal development demands; but, whereas normal development implies merely the replacement of shorter by longer methods, the idle fixed capital which now can be brought back into use makes increased demands on the banking system for accommodation. This demand is likely to be met without the actual rate being appropriately raised; we shall again have the rate of interest held below the natural rate, and the boom will be repeated even without the added stimulus of any abnormal non-monetary influence.

In the preceding analysis we have adopted one simplification which it is now time to remove. Whenever we have set income over against capital our main purpose has been to discover what factors lead to a relative change in the value of the one and the value of the other taken as wholes; but the time element which is the basis of the distinction between income and capital is the basis of a similar distinction between different kinds of capital. A capital inflation or deflation will, therefore, always be accompanied by a dispersal of values as between different kinds of capital, on account of what we may call the degree of capitalism [1] of the capital. For example, an expansion of credit by the banking system having led to a capital inflation, the interplay of lacking will lead to the inflation of the most capitalistic capital being greater than the inflation of the least capitalistic capital, or, in other words, a relative deflation of the latter as compared with the former. In other words, in terms of the total value of all wealth, some capital may conceivably fall in value, so long as capital as a whole rises in value. If we place income and capital in a series expressing a rising degree of capitalism, then values will pivot about an axis at some point in the series, those on the left nearest to present income falling, while those on the right rise as illustrated in Fig. 6.

The horizontal straight line, in Fig. 6, which represents the original series of quantities of income and capital having

[1] The " degree of capitalism " is the " average period " of the labour embodied in the capital, or, more precisely, the net production-factor of the labour embodied in the capital divided by the amount of labour, e.g. a piece of " simple capital " embodying 10 units of labour and 20 days from maturity may be regarded as having twice the " degree of capitalism " of a piece of simple capital embodying 50 units of labour and 10 days from maturity, since $\frac{10 \times 20}{10}$ is $2 \times \frac{50 \times 10}{50}$. The " degree of capitalism " of a piece of fixed capital is given by a more complex calculation, owing to the different periods of each unit of labour (see Chapter IV). Since " income " may be regarded as capital with a zero period of the labour embodied in it, the " degree of capitalism " of income is zero. (See also Chapter III and footnote to p. 33.)

equal values at the initial date may, of course, become curved in a complicated manner, and an appropriate response to any such abnormal influence, which we have previously described as a series of changes in future rates of interest, can also be described as a change in relative values of more

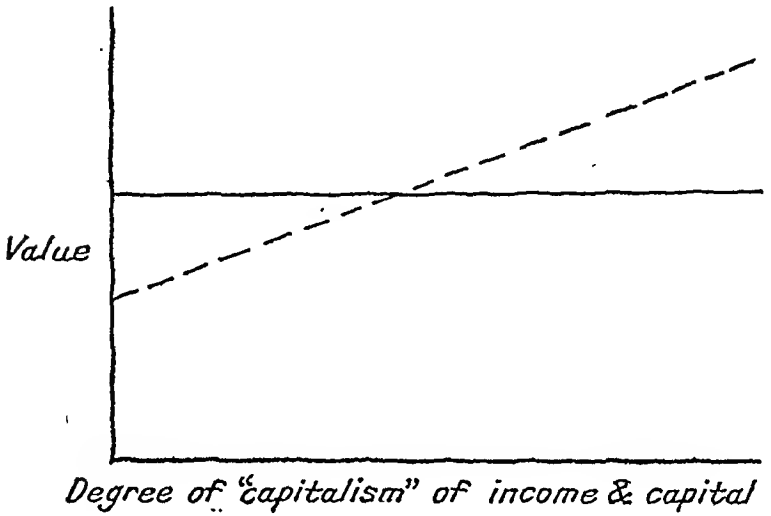

FIG. 6.—Illustrating the effect on values of income goods and different kinds of capital goods of a relative capital inflation. The continuous line represents values before the inflation, the broken line represents values after the inflation. Income-goods are represented by the two points on the y-axis, all positions to the right of this representing capital having a "period" of more than a day, which is our indivisible unit of time.

and less capitalistic capital and will be shown by the new dotted line.

If, at a given moment, the course of future interest, apart from the abnormal influence, is downward, and a new invention appears which causes the rate to undergo one complete fluctuation up and down, then the original values of income and capital are shown by the horizontal straight line, and values will move more or less as illustrated in Fig. 7, i.e. as the rates of interest become established, resources are

being diverted from the production of capital which will mature when the rate of interest is at its lowest to the production of capital which will mature earlier.

It follows, therefore, that with every different kind of fluctuation a different form of capital inflation will appear,

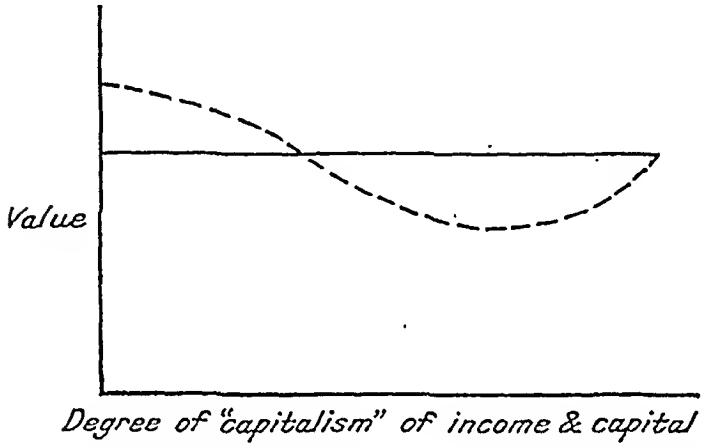

FIG. 7.—Illustrating the effect on values of income goods, and different kinds of capital goods of an abnormal influence, sufficient to cause a fluctuation in the rate of interest. The continuous line represents values before the influence, the broken line represents values after the influence and corresponds to the curve of short-period rates of interest.

associated with its particular type of dispersal of values, and in each such case the degree of capitalism of the various kinds of capital will give a different result. If capital were all of the simple type, merely maturing with the lapse of time, the curve expressing the changed relative values would be relatively simple; but since actual working capital and fixed capital have various degrees of adaptability and their products are heterogeneous, and the demands for them have various elasticities, the actual curve may, of course, be extremely complex.

One obvious point, however, emerges. A (relative)

capital inflation, with its associated commodity deflation, does not mean that capital-goods industries become profitable as compared with consumption-goods industries, but that more capitalistic or longer methods become profitable as compared with less capitalistic or shorter. In the case of any particular constituent of income, those businesses that are in any way concerned with a method of production which involves relatively much roundaboutness will find their profits increase at the expense of those that are producing the same thing by less roundabout methods. And those industries concerned closely or remotely with the production of consumption goods requiring the most capitalistic methods find their profits increase at the expense of simpler industries, to a degree dependent on the elasticity of substitution between the heterogeneous products. Industries producing fixed capital will, of course, on balance make profits, though the demand for many kinds of fixed capital will decline in favour of more capitalistic fixed capital. Similarly, a capital deflation, with its associated commodity inflation, brings losses not profits to the most capitalistically organized consumption industries; for however much they appear to gain through the increased margin between selling price and prime cost of the commodity, this gain is more than offset by the decline in the value of the capital used. It is the failure to recognize this fact that has led many economists to interpret that familiar phenomenon of boom, a rising demand for consumption goods, as a rising demand for capital in general, whereas it is, in fact, a falling demand [1] for capital in general—just as the falling demand for consumption goods, which is a familiar phenomenon of depression, is interpreted as a falling demand for capital, whereas in a mobile non-contractual society it would manifest itself in a rising demand for capital. If

[1] This is quite consistent with the fact that there will be a rising demand for many existing capital instruments previously idle.

economists fall into this error, it is not surprising that the banking system makes the same mistake; that the entrepreneur is pessimistic where optimism is called for and optimistic where pessimism would fit the situation better; that the general public concurs, and facilitates the banking system's unneutral behaviour by hoarding and dishoarding deposits at the wrong moment; and that the wage-earner is induced in a contractual world to accept an increase of work without an appropriate increase of income and a decrease of work without an appropriate decrease of income. Since all these forces combine to magnify the effect of the original error, it is surprising that the trade cycle is not more disastrous than it is; and when we take into account the increasing influence of contract, which further exaggerates the maladjustment in a way we have yet to consider in more detail, the increasing degree of capitalism may be expected before long to make the trade cycle so catastrophic that banking itself will be compelled to disappear by a process of natural selection.

The criticism of current monetary theory resulting from the analysis of this chapter it is convenient to postpone until we have dealt with the modifications of monetary theory made necessary when money is used not only as a medium of exchange but as a standard of value for the purpose of contracts through time; but it must be borne in mind that money can be unneutral in a non-contractual world and can generate all the main features of a trade cycle, at least on a miniature scale. The preoccupation of economists with money in a contractual world has led them to blur the analytic distinction between divergences from neutrality due to contract and those that would emerge even in the absence of contract.

Chapter X

MONEY IN A CONTRACTUAL WORLD

Unlike the pure theory of value, the pure theory of money is a theory of an imperfection in the mechanism of exchange. If money could perfect the process of exchange, it would not need to be held and would, consequently, have either no quantity or no value. The theory of money, therefore, assumes that money not merely serves as a medium of exchange but of necessity must serve as a temporary store of value; and the main implications of this we have dealt with in the preceding chapter. But money is also used as a standard of value for contracts; and in so far as this is the case complications arise of a different order, which are not theoretical implications of a pure theory of money, unless it is assumed to be of the essence of money to serve as a standard of deferred values.

It follows from the argument of the previous chapter that a neutral money is compatible with the existence of money contracts confined to all of one class of goods that are not diverging in value from one another through time, and the contracts may be for periods of any length. All that is necessary is that the value of money be perfectly stabilized in terms of this class, and the practical difficulty of achieving this is the smaller the larger the field that this group can be imagined to occupy in the whole of economic life. (Thus, if income consisted of only three kinds of economic cake, it would be easier to stabilize the price of one of these than to stabilize the price of bread or boots in the actual world.) The possibility of achieving such results has already been discussed.

The principal money contract in the actual world is the loan contract, a contract which may cover an infinite period. Of less importance is the wages contract proper; though the increasing non-plasticity of wages shows how profound is the effect of regarding money as a standard of deferred values, even when contracts are technically for short periods only. Of relatively minor importance are the various money contracts relating to particular constituents of wealth, such as leases of property (though some of these, since in certain connections they are predominantly affected by the same influences as the above-mentioned loan contracts are quite naturally treated as a sub-group of the latter).

It follows from this that if by a suitable policy of neutral variation in the quantity of money (i.e. by changing the quantities held by everyone in proportion to holdings) we stabilize the commodity value[1] of money, approximate neutrality can still not be preserved, unless we abolish loan-contracts and wage-contracts (including quasi-contracts); and, therefore, in practice a stable income value of money is by no means the most desirable objective of monetary policy. Preferable to this would be a policy stabilizing the money-value of labour, which, in practice, would mean stabilizing an index-number of the values of different kinds of labour. But if, in practice, we are unable to abolish the loan contract, this might be even more disastrous than stabilizing the commodity-value of money, owing to the falling income price-level that would result from the developmental tendency of the income-value of labour to rise.

Since, in practice, loan contracts seem to be incapable of eradication, then (in spite of the difficulties presented by the non-plasticity that accompanies the semi-contractual

[1] The commodity (or income) price-level, in this case, means of course some arbitrary index-number of income-prices—not a total money-value, but something arbitrarily called an average value of constituents of income.

element in labour agreements) a policy of neutral variation in the quantity of money, so as to stabilize the money rate of interest, appears to be the most satisfactory objective, for it is the only policy likely to maintain approximate neutrality. Since, under normal development, the natural rate of interest is trending downwards (though, owing to the effect of such things as inventions and windfalls, the downward trend is accompanied by fluctuations), a stable money rate of interest must carry with it a rising commodity price-level (fluctuating, however, whenever the natural rate of interest undergoes a fluctuation). Provided that all money contracts, other than loan contracts, have been abolished or are for sufficiently short periods to be of no appreciable significance, all price-movements will be appropriate and minimize the trade cycle instead of, as happens under modern stabilization policies, magnifying it, by failing to allow the appropriate movements of prices. The question of what, in practice, such a policy implies will be left to the next chapter.

Let us return to a consideration of the unneutrality of money that is to be found under the existing system of money contracts.

The consequences of the quasi-contract in wages are simply those that result from non-plasticity with its consequences in under-employment or over-employment; for the wage contract takes the form of an agreement to pay a certain money wage, but not an agreement to continue to employ at this money wage. Non-neutrality, on this count, is, therefore, at a minimum, when the money-value of labour is not changing, and labour is fully employed. (It must be remembered that unemployment in this country is also, in part, a consequence of monopolistic action on the part of a labour force the power of which is enhanced by the existence of unemployment benefit, only partially financed by the bargaining workers, so that the equilibrium

money-value of labour coincides not with what would be the money-value of labour if all were fully employed, but with the money-value of labour when it is employed to a somewhat less extent owing to these influences.) In a developing community (especially if the community is one in which the population is increasing), the demand for money is likely to be increasing ; and, therefore, unless the quantity of money is increasing, the money-value of labour as of all things is likely to be falling, so that the non-plasticity of money wages is likely to keep them too high. A constant quantity of money (which gives approximate neutrality in a non-contractual world with stationary numbers) will, therefore, cause unneutrality in a world of non-plastic money wages. Banking policy does not, however, meet the difficulty, since, not being directed with a view to stabilizing the money-value of labour, it tends to make wages first too low and then too high if it overrides the oscillations in the natural rate by smoothing out the rate of interest, and tends to make wages too low if at other times it attempts to stabilize prices.

But the most important non-neutrality feature arises out of the loan contracts. In a developing community (with a stationary population) the tendency of the rate of interest is, as we have seen, downwards, except in so far as catastrophes, and the invention of new wants thwart this tendency. If we take as normal a falling rate of interest, then the loan contract gives an unexpected bounty to previous lenders which is mitigated only when abnormal influences (such as new inventions) temporarily raise the rate of interest.[1] We have seen that, in so far as there are wage agreements of a quasi-contractual nature, there is seldom a contract to continue employment beyond a short period, but there frequently is such a contract in the case

[1] Abnormal influences are sufficiently common as to make it unlikely that one general view as to the future rate of interest for even a moderate period be held simultaneously by all concerned.

of loans (e.g. in irredeemable debentures), so that quite trifling changes in the rate of interest produce quite startling instances of disequilibrium, just as a quite trifling divergence between the value of labour (if fully employed) and its established price would produce startling consequences in a very short space of time if each particular kind of labour had to be continued in employment at the contractual rate when the value of the marginal net product of that quantity of labour was falling. The effects of a change in the rate of interest are easily seen in the case of a joint stock company which has raised its capital by the issue both of debentures and of shares. If the rate of interest subsequently diverges from the debenture interest (allowing for the original excess of the debenture rate over what would have been the rate of interest if the debenture-holders had felt there was no risk associated with the loan), there are necessarily mutually compensating movements in the valuations of the two types of securities. Thus, where there are contractual and non-contractual claims to the earnings of specific capital, an unanticipated movement in the rate of interest means an inflation of one set of values at the expense of a deflation of the other set, e.g. an inflation of debenture values, if the rate of interest falls, at the expense of a (relative) deflation of share values.

Let us call this phenomenon debenture inflation or debenture deflation, as the case may be; then, as regards the total of real capital, which is owned and mortgaged by means of shares and debentures, its total value as expressed in the total value of shares and debentures (if the latter are perpetual) is unaffected by the amount of debenture inflation or deflation, which is merely a change in the relative values of shares and debentures. (Of course, if a debenture inflation has come about through a fall in the rate of interest the total value of all shares and debentures will have risen; but this total value has nothing

to do with the proportion of shares to debentures, for it would be the same whether all capital were share capital or only a small fraction). Now, if the bias of debenture-holders towards buying or selling capital or income, when there is a change in these relative values, were no different from that of shareholders, then the monetary element would be approximately neutral, as between capital and income, i.e. there would be no reason to expect a capital inflation or deflation. But there is every reason to expect that there is a class of persons who favour holding debentures rather than shares, while there is a different type with a preference for shares, and the holdings of very few will be so balanced as to be unaffected by a debenture inflation or deflation. If, for instance, debenture-holders as a class have a more rigidly unchanging demand for immediate income than share-holders as a class, then a debenture inflation will give rise to some degree of capital inflation, owing to the debenture-holders' bias towards purchasing (or continuing to hold) capital when their wealth is increased (instead of increasing their income expenditure by selling part of their expanded capital), and a bias which outweighs any tendency towards selling capital generated amongst shareholders [1] (since shareholders will tend to economize in expenditure on income).

By no means all contractual interest arises in this way. Public authorities raise loans for capital development

[1] If we take into account various rigidities of the actual economic system which we are hardly justified in considering in pure monetary theory, the unneutral effects of debenture inflation and deflation are far-reaching. Particular firms and even particular industries are put into a relatively favourable or unfavourable position, adjustment by bankruptcies may be hindered, and the rise of new firms uneconomically retarded or accelerated, so that the distribution of internal and external economies is affected in such a way as to affect average cost of production, and the choice of investment by the public is distorted. If there were perfect competition and mobility of labour, there would, of course, be no such effects, since every firm and every industry would continue to be of optimum size; though the formality of bankruptcies would cause changes of ownership of capital, and the rise of new firms would, of course, be unaffected.

without reference to specific capital, and also for consumption, and consumption loans take place between individuals or groups. Now a perfectly secure consumption loan would be equivalent to a purchase of real capital from the point of view of the lender only if the value of the loan continued to remain equal[1] to the value of a representative bundle of capital which might have been purchased instead of the debt (i.e. the value of capital for each particular lender, if he had bought capital, but not, of course, the value, if all lenders had bought capital; for, if such loans are of sufficient magnitude in a community, the quantity and value of capital is affected). The changes in the values of such loans brought about by a movement in the rate of interest may, therefore, be regarded simply as a redistribution of wealth as between these borrowers and lenders. Now the bias of this particular class of borrowers towards capital as compared with income may well be different from that of the class of lenders, and therefore capital inflation or deflation may well result from the existence of loans of this type, whenever there is an unanticipated movement in the rate of interest.[2]

Since the loans of State and municipality rarely refer to specific capital, it is only possible to speak of a relative inflation or deflation of the value of these loans, as compared with the value of capital, by comparing the movement of the total value of all loans with the movement of the total value of all capital. If the total value of all loans rises more

[1] I.e. rising and falling as illustrated in our figures.

[2] Let us, for example, suppose that consumption loans result, in the main, from the attempt on the part of borrowers to maintain a certain standard of living. Then a debenture inflation will involve some capital deflation since the windfall increases of values accruing to the lenders will cause some increase in the demand for income goods on their part while the borrowers will continue to attempt to purchase the same real income. Since this (relative) capital deflation would not have occurred but for the financing of consumption in this contractual way, the rate of interest is kept higher than it would have been if all such loans had been convertible from day to day (in the same way as bank overdrafts) so as to subordinate the contractual element.

than or falls less than the total value of all capital, we shall speak of a debenture inflation (which now includes what might be called "gilt-edged" inflation, and the inflation of any other loans, such as consumption-loans between individuals). Whenever the rate of interest falls there is, therefore, necessarily a debenture inflation (since the total *money*-value of loans is bound to rise more or fall less than the total *money*-value of capital). It is not difficult to see in general outline the unneutral effects of debenture inflations and deflations in this widest sense that result from the great mass of public loans, but it may be remarked that either capital inflation or capital deflation may result from a debenture inflation, one of the main considerations being the general nature and the special characteristics of the tax system.[1]

[1] For example, let there be a fall in the rate of interest (developmental, or a phase in an appropriate fluctuation) with its corresponding (relative) capital inflation. The consequent debenture inflation is likely to lead to still further capital inflation (i.e. there is an unneutralized monetary influence) if the tax system is an unprogressive one; for at least part of the interest paid to the bond-holders (an amount that would not have been as great if the loans had been from day to day) is contributed by those who hold no capital and therefore have to contract their demand for income goods, while the bond-holders will not (as a consequence of the increased valuation of their holdings) expand their demand for income goods to the same extent (i.e. the increased valuation of their loan holdings will lead to an increase in their demand for income which is less than the decreased demand for income of the poor). No tax systems are likely to be sufficiently progressive to prevent this capital inflation effect of a fall in the rate of interest (i.e. the unneutral capital inflation flowing from the debenture inflation which results from an appropriate capital inflation), or the capital deflation effect of a rise.

This monetary unneutrality must, of course, be distinguished from the effect on the rate of interest of State borrowing. In so far as the State is undertaking public works which development requires, future rates of interest are being appropriately determined by the whole demand for capital, which includes that of the State, for only in so far as public works utilize a very small proportion of all resources can the State act as if future rates of interest were already determined independently of its own behaviour. The amount of such expenditure required for equilibrium-development is, however, just as determinate, whether its application of the community's resources in this way is a large or a small part of the total application of resources (whether that social organization is predominantly collectivist or individualist). If the State raises a sum of money by public subscription for use on developmental works and, owing to the rise in the rate of interest, causes debenture deflation and capital deflation (over and above the developmental change in the value of capital

Let us now pass from pure monetary theory to what might perhaps be called approximate monetary theory—from the theory of modifications of relative values, brought about by the existence of money used both as a medium of exchange and as a standard of deferred values, to the theory of movements of values in relation to some special set of values taken as a standard, which over a period of time is regarded as moving in some satisfactorily representative manner (involving, therefore, the use of an index-number to express this fact). Let us first consider a very short period of time, which enables us to approximate to pure theory. Let some

consequent on this appropriate investment), the net capital deflation (in the relative sense) is the resultant of two forces, one of which may be described as non-monetary (i.e. the demand for capital by the State, whether or not this is developmentally appropriate) while the other may be described as monetary (i.e. the debenture deflation leading in capitalist societies, as we know them, to some further capital deflation) though selective systems of taxation are conceivable which by differentiating between loan-holdings and capital-holdings might neutralize these effects or even produce some capital inflation to counteract the appropriate deflation. Owing to the existence of a banking system, a further monetary influence may be brought into play (which tends to act in the direction of capital inflation) through the expansions of credit that are generally associated with the issue of public loans; for such an expansion obviously forces the rate of interest below the natural rate. The net monetary distortion of the rate of interest and of the income-value of capital is, therefore, the resultant of the combined influences of these diverse factors. An appropriate public works policy requires, therefore, that when an abnormal influence raises the natural rate of interest, there should be some temporary contraction of such investment so as to release resources, and when the natural rate of interest subsequently falls, some temporary expansion. If, in addition, there is a banking system forcing the rate of interest apart from the natural rate, the State may reduce the departure by reduced borrowing from the banking system during the boom and increased borrowing during the depression. If, however, the banking system during the boom is lending to what it treats as the limits of safety, the reduced borrowing by the State may only have the effect of accentuating the general over-investment and forcing the rate of interest still further below the natural rate. (For public works are on the whole endowing a distant future the appropriateness of which is not appreciably changed by boom conditions. The resources liberated tend, therefore, to be utilized where they are less appropriately required.) Since, in the subsequent depression, the banking system would lend more at current rates if it could, this objection does not apply, and State-borrowing is bound to be beneficial. Since there is one kind of expenditure by the State that has special features of its own, namely, the ever-fluctuating claims of unemployed workers, it is possible for the State to increase its borrowing during depression without the necessity of expanding public works to more than the appropriate extent.

influence, monetary and/or non-monetary, raise the price-level of capital and/or the price-level of loans, and/or the price-level of income. Then we have capital inflation, and/or debenture inflation and/or commodity inflation, if we use the terms capital inflation and commodity inflation in Keynes's absolute sense.[1] But even if they are all inflated together, there are the necessary relative inflations and deflations within the total of values, which we have already investigated. Now the total rise in money-values is the total of money-earnings, since we include in money-earnings the gains from an increase in the money-value of capital held. Let us call this the total inflation and let us call the difference between money-earnings and money-expenditure on consumption the total "money-saving". This money-saving is the excess of total inflation over commodity inflation, and, neglecting the disturbance due to debenture inflation, or deflation, is also equal to the capital inflation.

Now the total rise in money-earnings is distributed between a rise in the value of various kinds of capital (the extent of the rise varying [2] with the differences in the degrees of capitalism of the different kinds), a rise in the value of each unit of land (differing similarly from unit to unit according to its equivalent degree of capitalism) and a rise in the value of labour; therefore, adjustment-friction (when the total inflation is associated with a relative capital inflation) causes profits to emerge in the production of more capitalistic capital and in the more capitalistic methods of production of consumption goods, and losses in the production of less capitalistic capital and in the less capitalistic methods of production of consumption goods. If, in addition, there is a lag in wages and therefore a relatively greater increase in the monetary value of other

[1] Keynes, *Treatise on Money*, chap. xi.

[2] In the special case of a sheer increase in the quantity of money distributed in the way described in Ch. IX, these variations will not, of course, appear.

earnings, (i.e. a greater degree of capital inflation and a less degree of commodity inflation, combined within the total inflation) profits will also emerge in all production to add to the profits of the more capitalistic producers and mitigate the losses of the less capitalistic. Equilibrium is restored as soon as these abnormal profits and losses disappear.

On the above assumptions, the commodity inflation is necessarily equal to the wages inflation or, less ambiguously, the rise in the total money-value of income is equal to the rise in the total money-value of labour (the words labour and wages here covering, of course, much more than is commonly so called in a contractual society). If the price of labour lags, the commodity inflation lags, and the capital-inflation is accentuated; but as the price of labour rises or it becomes over-employed at unchanged rates, the commodity inflation increases at the expense of the capital-inflation (since the immediate effect on total income is negligible). If, however, what is sometimes called an increase of saving (a relatively reduced readiness to buy income over against the readiness to buy or hold capital) is the sole cause of the capital inflation, there will be no commodity inflation if total wages lag behind the total increased equilibrium value of labour, and commodity inflation will not appear until wages rise or over-employment occurs. If with this increased reluctance to buy income-goods, there is also an increased reluctance to buy capital (i.e. an increased demand for money), there could be a commodity deflation and a lessened degree of capital deflation (or even a capital inflation); but this will not affect the situation as regards production of income and capital if there is no lag in wages, and the relative capital inflation will still bring about that investment and that future saving that always accompanies the adoption of lengthier methods of production. In so far as wages lag, the adjustment will, of course, be slowed down and associated with some temporary unemployment. It

would seem, therefore, that Keynes[1] is mistaken when he suggests that an attempted increase of saving could ever produce the disastrous consequences he describes in his parable about bananas. If the intended thrift takes the form of an increased holding of money and there is no wages lag, then we have a capital deflation, commodity deflation, and wages deflation, and no relative change in values (i.e. no relative deflations), and, therefore, no emergence of profits or losses and no change in the output and consumption of bananas; but the banana-value of money has increased. The community can continue to indulge as long as it wishes in these acts of apparent thrift without any evil consequences whatever, enjoying meanwhile an increasing self-complacency from the increasing value of its unchanged money holdings. If, however, there is a wages lag, the capitalist-entrepreneurs will reduce employment in the effort to maintain profits normal (i.e. prevent either profits or losses in Keynes's sense), and the total money-value of bananas will still equal total money-wages (if we include the remuneration that the entrepreneur still gets) though there will now be fewer bananas. Only if we assume that an increasing divergence between the equilibrium money-value of labour and actual money wages is unable to accelerate adequately the fall in wages would it be possible for a continuing increase of thrifty intentions to maintain an output of bananas less than the original output. Suppose now that this increasing "thriftiness" (relative willingness to sacrifice income-goods for money or capital) leads to a relative capital inflation, so that the commodity deflation is greater than the capital deflation, then if there is no wages lag the total money-value of bananas will still be equal to the total actual money-value of wages[2]; but more capitalistic methods of

[1] Keynes, *Treatise on Money*, pp. 176 seq.

[2] We are assuming, as Keynes appears to be assuming, that there are only wage-earners, all of whom are similar, and entrepreneurs, so that

producing bananas have become more profitable than less capitalistic and the apparent thrift gives rise to some investment (in our sense), in so far as longer methods are available. If, for any reason, this investment fails to take place, because, for example, there are no methods of production more capitalistic than those already in use, wages must fall to a lower level than would be the case if more roundabout methods were available (so as to prevent the losses that would otherwise occur) and the community again succeeds in apparently accomplishing its purpose, without any loss of banana-income, but in this case it is shown in the increased banana-value of capital, with or without an increased banana-value of money.

In the latter part of this discussion we have attempted to bring into relationship the processes and effects of monetary saving and capitalistic thrift. At one extreme we have money-saving which leads to no real saving, owing to the absence of a relative capital inflation, and at the other extreme money-saving which gives rise eventually to real saving, by means of a relative capital inflation (provided that there are appropriate more capitalistic methods of production available).

Now, in Keynes's treatment,[1] monetary saving and real

we can neglect the rate of interest in the sense that we are assuming that the whole income takes the form of wages.

[1] Subsequent modification by Keynes of his treatment of Saving and Investment may make some of the comments of the following pages seem no longer applicable. But these comments were not intended as a summary criticism of Keynes's procedure in all its details. The points mentioned were selected in order to illustrate what appears to us to be his unsatisfactory treatment of the quantitative aspect of capital. His present treatment of Saving as necessarily equal to Investment involves the complete abandonment of the attempt to separate the quantitative from the value aspect of capital (a problem that was at least recognized in the *Treatise*) and a reversion to that more customary identification of the two aspects which in his more recent work he singles out as unsatisfactory in the work of Pigou. He here goes so far as to assert that the calculation of the quantitative aspect (his former C) so as to distinguish it accurately from the value aspect (his former I) " presents conundrums which permit, one can confidently say, of no solution ". (*The General Theory of Employment, Interest, and Money*, p. 39.)

saving, or saving and investment, to use Keynes's terminology, are treated by Keynes as if they were independent, though he admits the existence of equilibrating forces tending to bring them to equality (with the one exception of the banana parable). But, while he makes saving the excess of earnings over expenditure on consumption, he does not include an increase in the money-value of capital as part of earnings. For him earnings are equal to the total cost of production of total output, exclusive of profits (other than normal profits). Output is made up of investment goods and consumption goods, i.e. capital and income as I have used the terms. Therefore, output over a period sufficiently short for changes within it to be neglected consists of an increment of capital and the consumed income of the period. This is where our difficulties really begin ; for whenever there is an increment of capital (an increased income-value of aggregate capital, as I should prefer to say) it is necessarily composed of a reduction of some items of real capital and an increase of other items. There is, therefore, no measurable quantitative increment. There is, however, an increment of value ; and, on the theory of this book, there is no other measurable increment (of the kind required by Keynes's argument), owing to the asymmetrical structure of production implied by development. Keynes attempts to escape this difficulty by deducting from the changed total of capital all the items of real capital which are unchanged, and then makes the increment of investment consist of everything else existing after the change minus what has disappeared—one set of items of wealth minus a different set of items of wealth—a treatment which allows of no purely quantitative statement of increments or decrements.[1] The first set of items will, however, have a value and so will the second set, which gives a meaning

[1] This truth seems to be recognized in Keynes's discussion in his later work (which appeared after these chapters were written) of Pigou's treatment of this problem. (See preceding note, p. 217.)

to value of the increment of investment, and this may, of course, have any relationship to the increment of value of investment (i.e. increment of value of capital). I, in Keynes's nomenclature, is, therefore, the value of additions to capital, minus the value of subtractions from capital, while C must express the additions to capital minus the subtractions from capital. It follows that I', the cost of production of the increment of investment C, needs to be defined as the cost of producing the additions to capital minus the cost of producing what has been subtracted. At this point we find our difficulties becoming acute, because we cannot picture the community as dividing its efforts in two contrasted ways, the production of capital and the production of income goods. For (apart from the negligible case of direct labour) we can only see the community as engaged in the production of capital.

If the community is to produce more consumption goods, it must produce more capital, or else adopt a less capitalistic method of production; and only in the latter sense is it able to produce consumption goods instead of capital. Yet Keynes assumes that we have on the one hand the cost of production of investment goods (i.e. capital), and on the other hand the cost of production of consumption goods (i.e. income in our sense). Let us, then, see if it is possible to give a meaning to the cost of production of C, the increment of investment (re-defined as we have found it necessary to re-define it). If, let us say, the amount of 1st day simple P-capital has increased (as between one date and another) by 1 unit, then the cost is the price of a unit of labour and if 1st day simple (P − 1)-capital has diminished by 1 unit, then the cost is again the price of a unit of labour, so that the cost of production of the increment (1 unit of 1st day simple P-capital minus 1 unit of 1st day simple (P − 1)-capital) is zero. But if P-capital is increasing at the expense of (P − 1)-capital, there will be an increase of nth

day P-capital and a diminution of nth day (P−1)-capital for all values of n.[1] What is the cost of production of these items? Is it the price that a producer will pay for this increment of nth day P-capital minus the price that a producer ceases to pay for the nth day (P−1)-capital which is allowed to diminish? Or, if it is working capital, is it the sum of the price he pays for it and the price of the labour he applies to it *minus* the sum of the similar prices he has ceased to pay? Some such complication of Keynes's statements seem to be called for and it is difficult to see how in this more complex form they can be used for his equations.

Perhaps we shall do better by taking the cost of production of income (i.e. consumption goods). If we have a given output of a commodity produced by a given method, the cost of production will in Keynes's view be simply the total of wages (including entrepreneur remuneration) plus the interest on capital. But if at the same time the industry is moving to a more "capitalistic" method of production, it would seem to be the case that only the interest on the new kind of capital which is involved in the present output (i.e. that would be required for that output in a stationary state) that should be included under cost. Total cost of production of current income (when both methods are simultaneously yielding income) will now be less than the total cost of production of all output; and the cost of production of total income will include costs of production by less capitalistic methods and costs of production by more capitalistic methods. Total earnings will be equal to the sum of these costs of production. If the proportion of these earnings spent on income is equal to the cost of production of income (which is made up of two costs of production by two distinct methods) then the remaining

[1] This continues until all (P − 1)-capital has disappeared. Thereafter, there is a simple increase of P-capital, unless production of (P + 1)-capital immediately begins to replace production of P-capital.

earnings will be spent on the remainder of output (the increment of investment, i.e. the growing more capitalistic capital minus the diminishing less capitalistic capital) so as to have a neutral effect on its value; and profits emerge from the more capitalistic methods if there is a lag in their rate of adoption, with counter-balancing losses from the less capitalistic, and it appears that $I = I' = S$, in Keynes's sense.

Now, as Keynes points out, earnings may not be spent in such ways as to give equilibrium in the above sense, for they may be spent on income, on capital, or not spent. Let us first assume that there is no change in the demand for money, and money-earnings are unchanged; then, if less is spent on income, so that S increases, there is commodity deflation and capital inflation, which accelerates the movement to the more capitalistic method. In so far as total costs of production cannot fall immediately, this capital inflation increases the difference of cost between the less and the more capitalistic methods so that profits from the latter method and losses from the former are increased, owing to the rigidity of capitalistic structure; and the capital inflation might, of course, be sufficient to make even more capitalistic methods desirable now. In other words the total cost of production of income goods lags behind their total price only to the extent to which there is a lag in the abandonment of less capitalistic methods. The departure of $(I-S)$ from zero is, therefore, a necessary mechanism for ensuring the proper adaptation; and the attempt to correct it by banking action will only make matters worse, since it will increase still further the capital inflation. In fact, if the decreased spending of earnings on consumption were merely a short-period thriftiness on the part of the public, the proper response of the banking system would be to contract credit and prevent the fall in interest, so as to prevent an unnecessary oscillation in

the structure of production. But not only may the public decrease the expenditure of its earnings on consumption without changing its demand for money, it may combine this with an attempt to hold more money, and bring about a similar increase in S—a course of action that need not involve a capital inflation though it must involve a commodity deflation. The *relative* capital inflation is not altered by the changed attitude towards money, and the rate of interest (the relative values of capital and income goods) falls to just the same extent. No doubt wage rigidities and the debenture inflation that accompanies rigid contractual interest give some justification for banking expansion intended to bring (I — S) to zero, but is still open to the objection that it increases the relative capital inflation. Such an inflation we hold to be a correct interpretation of the public's wishes (wise or foolish) ; but it is clearly undesirable that it should be magnified in this way.

We may now, perhaps, draw the following conclusions. The decisions of the community as to the division of its earnings in the three directions of expenditure on income, capital, and money can be regarded as a fundamental factor in the process of development. If, therefore, investment (in the sense of purchase of capital) outruns saving (in the sense of desire to spend on income goods), or saving outruns investment, this would be no reason for acting by means of banking policy either on saving or investment to bring them to equality, unless we consider the savings banking we have already discussed as a means of offsetting variations in hoarding to be describable as banking policy. But owing to money serving also as a standard of value for contracts, adjustment is interfered with ; and, if no other device existed, it would be desirable by banking policy to vary the quantity of money, and suffer the unneutral consequences of this (its forcing of the rate of interest to diverge from the natural rate), in order to avoid the worse

evils of price movements which cause divergence between wages and the equilibrium value of labour, and the evils of debenture inflations and deflations in excess of or opposed to appropriate capital inflations and deflations. Since, however, an equivalent of neutral variations in the quantity of money is attainable (as will be shown in the next chapter), such as will move the total price of capital roughly as we will, it is theoretically possible to produce something that may be described as a stabilized money rate of interest, and thus avoid the major difficulties of the use of money as a standard of deferred values. It remains, therefore, to suggest the lines on which a monetary system might be constructed to achieve this objective, and a tentative effort will be made in the next chapter.

Chapter XI

A NEUTRAL MONETARY SYSTEM

It follows, from the argument of the previous two chapters, that a neutral monetary system would seem to require the fulfilment of the following conditions, which at first sight may seem to be mutually incompatible :—

(*a*) A quantity of "money", variable only at the will of a central authority, capable of and aiming at preserving the proportions in which money is held by every member of the community, at any moment when the total quantity is varied.

(*b*) A constant "money" rate of interest, which is kept equal to the natural rate of interest, by an appropriate policy under (*a*).

(*c*) The prohibition of all (except very short-period) contracts involving monetary units, excepting the familiar loan-contracts in which both items in the contract are so stated (e.g. we may borrow and lend £100 for £5 a year but we may not contract to pay £5 a week for labour for any period not in the ordinary sense of the word short).

The first condition is readily fulfilled by varying the number of units of what we shall call accountancy money represented by a unit of ordinary (or, as we may name it, concrete) money. This, in effect, is to divorce the medium of exchange from the standard of deferred values—the latter being the kind of money referred to in paragraph (*a*)—and to link the two by establishing a rate of exchange between them by fiat of the State ; and it implies a State sufficiently powerful to enforce under heading (*c*) the making of contracts in terms of the accountancy unit. Since, in practice, the

individual published changes in the accountancy value of the concrete unit would be inappreciable, except when startling inventions and windfalls manifested themselves abruptly, there would appear to be nothing wildly unpractical in this proposal.[1]

Since the object of this variation in the quantity of accountancy money is to vary the accountancy price-level (in effect the amounts of payments on account of interest to loan-holders), we cannot, of course, assume that it is desirable to keep the quantity of the medium of exchange (concrete money) constant, owing to the variations in relative demands for money for purposes other than mere

[1] If it were possible to enforce all pricing in terms of accountancy money, an alteration in the accountancy-value of concrete money would be exactly equivalent to an approximately neutral variation in the quantity of money, a variation which we assumed to be possible in the theoretical argument of Chapter IX. A movement of the exchange would then be equivalent to the money in each person's possession magically changing in quantity by a given percentage, which, in the absence of friction, would mean that all prices would automatically be changed by this same percentage. If the quantity of money magically changed in this way, we could not assume this friction to be negligible (even if there were a simultaneous awareness on the part of everyone of the behaviour of every other person's stock of money); but if, instead of concrete money changing in quantity in this way, the movement of the exchange rate (between concrete and accountancy money) were periodically announced, we need suppose no friction; for prices would immediately be multiplied by the appropriate multiples given by the movement of the exchange rate, so that the new price-level would be equivalent to an unchanged concrete price-level. Although our neutralizing policy assumes, therefore, that actual prices will continue to be stated in terms of concrete money, the theoretical basis of the policy is most easily understood if we think of all prices in terms of the accountancy unit. Since the rate of interest in terms of money is the money-price at one time of income at another time, it immediately follows that, given the possibility of neutrally varying the quantity of money through time, this money price at one time of income at another time can clearly be held at any figure we choose. If in the actual world it were possible to change the concrete money itself on this plan (by an invisible ray—or, shall we say, visible ray, the action of which can be seen by everyone—acting on every person's pocket and every person's bank account), such a monetary system, controlled in the way we are suggesting, could be described as a neutral one. Since all we can do is to have an equivalent arrangement requiring, however, two ways of stating prices (in terms of concrete units and of accountancy units respectively), it is perhaps better to describe our suggestion as a neutralizing interest policy than as a neutral monetary system.

exchange-convenience. On this account we must insist on the replacement of the banking system by a state savings bank (accounts in which constitute the only bank-money of the community) which would neutralize by appropriate purchases and sales of assets the effects of changes in hoarding, in such a way that for every variation in the hoarding of deposits there is a variation in the creation of deposits to counterbalance this; in other words, the savings bank must keep the quantity of deposits, other than time-deposits, constant, thus fulfilling the double function of providing the principal medium of exchange, cash-deposits, and providing a convenient method of investment for the public by means of time-deposits, to the holders of which the full yield on the purchased assets will be paid, subject, no doubt, to a small charge for the services rendered (any changes in the relative cash-deposit requirements and cash requirements of the community being, of course, met by the purchase or sale of cash-deposits with cash created or destroyed for the purpose).

The second condition is easily fulfilled, provided the State is a sufficiently important borrower. New issues are offered at par in terms of accountancy units at the standard rate of interest, which the State is maintaining constant. If any particular loan is over-subscribed, this indicates that State loans at the standard rate have become more attractive than the direct purchase of capital (or, in other words, that there is a momentary failure to maintain the constant standard rate.) To remedy this the State in effect increases the quantity of accountancy money by lowering the exchange-value of accountancy money in terms of concrete money. Similarly, if the loan is under-subscribed, the reverse procedure is called for. The exchange-value of the accountancy unit from day to day is, therefore, more or less automatically regulated by the requirement that the loans of the State should be neither

over- nor under-subscribed. Thus the department fixing the exchange-value of the accountancy unit proceeds, by continuously correcting mistakes before they become appreciable.

It might be objected that the virtual abolition of the great divergences (to which a banking-policy has accustomed us) between short and long loan-rates would be disastrous [1] in its effects upon entrepreneur activity or the activities of the State when engaged (say) on armament production. The answer to this objection is, I believe, that these low rates do not express the fact that real short period investments at such low productivities are desirable, and that they do not, as a matter of fact, take place. They are, in the main, an accidental by-product of banking policy, which is compelled under competitive banking to emphasize the importance of perfect banking liquidity.

If they did express the short-period natural rates of interest that emerge when an appropriate fluctuation takes place as a result of an abnormal influence, the case would be different; for they would then represent such actual investment or disinvestment (lengthening or shortening of the period of production) as is taking place as the appropriate response to the abnormal influence. The point may be made clearer by considering the significance of changes in short-period interest rates.

If we draw up a schedule of future rates of interest (i.e. the value of each day's income in terms of the next), then the rate of interest over any given period is the value of the first day's income in terms of the last day's income of the period, divided by the period; or, in other words, it is the geometric mean of the rates of interest over the period. Let us call such an average over any short period the short-period rate of interest for that period on the

[1] If business habit would still require the convenience of short loans, the bank would be perfectly able to supply these loans at the standard rate, simultaneously, of course, selling securities.

first day of the period. Then if the rate of interest is falling any short-period rate is the geometric mean of the rates over that period, and the shorter the period the higher the rate. If, however, the rates of interest (i.e. from day to day) throughout such a "short period" first rise and then fall and then rise (the typical behaviour of the rates in response to a new invention), the short-period rates as thus calculated from the opening date are more complex. If, before the abnormal influence appears, the movement of developmental interest were expressed diagrammatically by a downward-sloping curve, then, at the moment the abnormal influence was felt, the new equilibrium-movement of the rate of interest (on the assumption of an equilibrium-fluctuation) would be expressed diagrammatically by a hummock followed by a depression in this curve; and, therefore, at the moment the abnormal influence was felt, very short-period rates of interest calculated from that moment would be greater the longer the period, while longer short-period rates would be greatest for the shortest of these longer short periods and least for the longest of these longer short periods. This is illustrated in Fig. 8 below.

Let us assume that the abnormal influence is an invention of an improved method of production. Then the first period of rising short-period rates represents the disinvestment in capital which would have matured later and the investment in new capital: increasing amounts begin to mature immediately subsequent to this first period. The next period of falling short-period rates is that in which the previous disinvestment bears negative fruit owing to the absence of income that would otherwise have appeared; while in the next period of rising rates, the methods temporarily resorted to are bearing fruit; and the period is one in which short-period rates are moving towards what they would have been but for the invention. Since shorter-period capital (outside the special sphere of

the abnormal influence) has been produced instead of longer period capital, this mitigates the fall in value of longer-

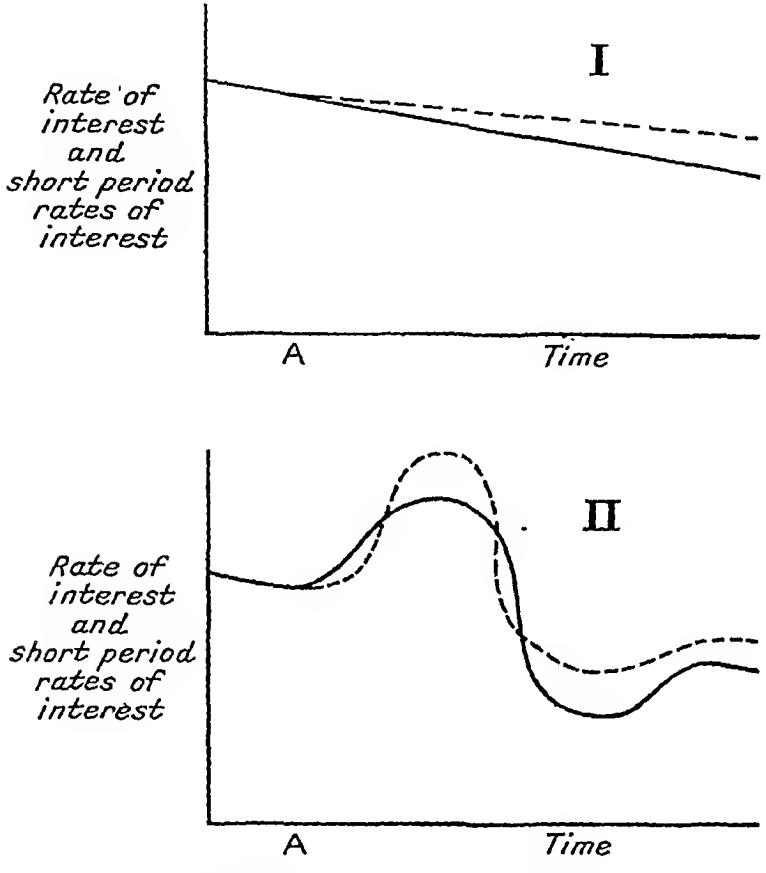

FIG. 8.—Equilibrium-movement of short-period rates of interest resulting from an " accident ".

In I the rate of interest from day to day assuming no " accident " is shown by the continuous line, assumed for convenience to be straight. Short-period rates of interest at moment A are shown by the broken line.

In II the rate of interest from day to day has undergone a fluctuation from an " accident " at moment A and the new movement of the rate of interest is shown by the continuous line. The resulting short-period rates of interest at moment A are shown by the broken line.

period capital, and the mitigation is expressed by a smaller rise in the longer short period rates as compared with the

shorter. Very long period capital will, however, be scarcely affected in value, since the resources temporarily attracted to the new method are being returned to the rest of industry and enabling longer methods again to replace shorter by appropriate progression, so that by the time this very long period capital matures into income the structure of production should have been more or less restored.

Pure theory requires a complex body of short-period rates of interest which, in the case of a new invention, are indicated by our diagram. (Actual banking policy dominated by the liquidity idea gives us, of course, another quite irrelevant body of short-period rates.)

If, therefore, instead of such a complex body of short-period money rates of interest that would be appropriate being established at moment A, we keep this money rate of interest constant, prices in terms of accountancy units must move up, then down, and then up, and relative prices of different kinds of capital and income must move to ensure an increasing capital deflation (in the relative sense), i.e. an absolute capital inflation less than the commodity inflation, followed by an increasing capital inflation (in the relative sense), i.e. an absolute capital deflation less than the commodity deflation, followed by a minor relative capital deflation (the last rise in interest), passing gradually into the normal developmental tendency towards relative capital inflation (the tendency of interest to fall continuously towards zero).

Since in the case of a new invention, we may assume that the public is mainly responsible for " providing the capital ", there will tend to be a withdrawal of time-deposits from the bank, so that the simultaneous sale of securities to prevent any creation of credit tends to cause a lowering of their values, including the values of government loans, which it is the bank's aim to maintain at par (with the natural corollary that government loans are now

under-subscribed). The monetary authorities have thus been warned to decrease the exchange value of accountancy money in terms of concrete money.

The price-level of income (if stated in accountancy units) is, therefore, bound to rise, but the relative capital deflation means that the price of capital as a whole (if stated in accountancy units) must rise less. Since, however, the income-value of long-period capital is not appreciably affected in those industries not improved by the invention (provided the elasticity of substitution of their products for those of the improved industries is not high), such capital will tend to rise in price to the same extent as income. Since very short-period capital is deflated least, the greatest deflation will be of intermediate capital, the price of which may even fall. Provided wages move appropriately (and since the income-value of labour is bound to move very slowly, a cost of living sliding-scale system will ensure this in an approximate manner), losses will emerge in certain industries which continue to maintain the production of the most deflated kinds of capital, so that the incentive to contract employment in these directions will be equal to the incentive to increase employment in the improved industries, i.e. to produce the one kind of capital which has risen in price by more than the rise of the income price-level. The price movements thus serve to maintain a constant money rate of interest for short and long periods, to create a disinvestment in certain old directions, and to check the investment in new directions, so as to maintain an equality between investment and disinvestment. If the public has become more thrifty, it throws this thrift into the future by decreasing the capital deflation, and it prevents attempts to achieve the impossible, an increase of investment balanced by an increase of saving now, and also prevents what is undesirable, an increase of investment balanced by an increase of work now.

It may be objected that this picture of an equilibrium-fluctuation is uninteresting, because prices of capital will not move in this automatic way. The public has its own ideas about future natural rates of interest, or no ideas at all, so that the prices of different kinds of capital will move inappropriately. This, of course, is true enough, but the kind of error that this introduces is only the error of choosing one investment rather than another and one disinvestment rather than another, and the subsequent discovery that there is a promise of too large a flow of some constituents of income and too small a flow of others. This is not the collectively biassed error of the trade cycle; and it may be expected to be corrected by the same processes with which we are familiar in static equilibrium theory, with the qualification that it is a developmental equilibrium, and that we equilibrate afresh after every mistake.

A different kind of objection must be met, based on the assumption that the differences in actual short-period rates are based on the differences of yields of short-period capital according to its period; and this objection may be coupled with an objection to the price instability which we have substituted for a medley of short-period money interest rates. If there were no long-period loans, the former objection would have some weight; for the various short-period rates would have some chance of being effective; but this assumption is disproved by the fact that the geometric mean of a series of successive short-period rates bears no regular relation to the rate over the whole period which includes them, and that this absurdity is not an occasional but a constant feature of our monetary system (e.g. it is not true that if money is borrowed for one month at 1% it is used to lengthen the period of production by one month, owing to the $\frac{1}{12}$% increase of productivity). In a world, in which all borrowing was by the month and not longer, the appropriate investment would tend to take place and

the money rate and the natural rate of interest would tend to move together, providing our only bank-money were of the savings bank type; and we could then have what movement of the actual price-level we liked, so long as the movement in one month were negligible.[1]

There still remains a third condition to be fulfilled if our monetary system is to be approximately neutral, *viz.* the abolition of all money contracts other than loan contracts. Since, in practice, contracts involving the prices of goods tend, on the whole, to be concerned with quite short periods, an unstable price-level, provided speculation is well organized, is not particularly harmful. But the contractual element in wages is a serious difficulty. There is, however, a way of escape, if wage-rates that result from collective bargaining are made to move with some suitable index-number of income prices. Under normal development this will, of course, tend to a slight degree of over-employment, (if there is a lag in the making of fresh bargains), owing to the rising income-value of labour; but it will lead to little over- or under-employment when the natural rate of interest undergoes a fluctuation; for, as we have already seen, the fluctuation in the income-value of labour is comparatively trifling, unless the new invention, want, or windfall is of very great importance and, moreover, the index-number can be made to compensate in the right direction, if it is constructed so as to reduce the influence of a disproportionately large change in particular prices brought about by such abnormal happenings.[2]

[1] Since this would enable us to stabilize the labour-value of money, it would, admittedly, be a more satisfactory system, though, unfortunately, less practical. It also follows that if short-period rates of interest could be made appropriate to short-period yields, we should have the advantage of a greater stability of prices. We have to choose between two evils, and only on the assumption that the evil of long-period money contracts is inevitable is it suggested that a price-system inconsistent with stability is the only alternative to the full horrors of a trade cycle.

[2] E.g. we must use (in addition to the usual weights) weights constructed on the basis of deviation of the movements of particular prices from the "average" movement of prices.

But even though appropriate plasticity can be introduced to a certain extent in this way, we have, also, introduced a new kind of unemployment whenever a fluctuation in the natural rate of interest takes place, owing to the disinvestment which is immediately initiated. The effects on unemployment that can be directly ascribable to labour immobility are enhanced, instead of being mitigated (though this kind of transitional unemployment would be wholly to the good if labour were occupationally mobile). Under the present unneutral monetary system, the failure of the rate of interest to rise to the natural rate during the upward phase of the boom allows the continuance of "capitalistic" production which should be checked, both through the failure of capital to fall appropriately in value, and the fall in real wages due to the rise in income prices, while the new investment is over-stimulated for the same reason, real wages being too low and the value of the new capital too high. Since the preceding phases of the trade cycle will have left a surplus of unemployed labour, this helps still further the aggregate over-employment. But, with money neutral, the new investment will not employ so much labour, while labour will be thrown out of employment in other industries earlier. Instead of this increase in aggregate demand for labour there will have been substituted an increase of demand in the appropriate special sphere accompanied to an appropriate degree by a decrease of demand in the industries where disinvestment is appropriately taking place, so that immobility-unemployment takes the place of increased employment. Fortunately, in the succeeding phase, when, under our unneutral monetary system, there is an all-round decreased demand and under-employment everywhere, our neutralizing method would again substitute for this decreased demand an approximately equal increase and decrease, and the unemployment would again, therefore, be only of the immobility variety.

The labour problem becomes, therefore, the familiar one of reducing the immobility of labour. Now, there is one social institution of modern times which has especially helped to increase both the non-plasticity of wages and even the immobility of labour, namely unemployment insurance, so that we are forced to the strange conclusion that the very institution which mitigates the severity of the trade cycle under an unneutral monetary system and incidentally perpetuates it by making tolerable what should be intolerable, reduces the benefits to be derived from a neutral monetary system, designed to abolish the trade cycle. But a community without a trade cycle could afford to substitute for the bribe, which just staves off revolution by preventing actual starvation, a more adequate arrangement, such as a universal pension to which wages are a pure addition. The greatly increased plasticity and even mobility that this would give, coupled possibly with other well-known devices for improving mobility, would reduce these unemployment periods to a reasonable minimum and transform what remains into well-earned holidays, mere intervals in the general continuity of wanted work.

Chapter XII

THE TRADE CYCLE AND DEVELOPMENTAL THEORY

The trade cycle theory that follows from the argument of the previous chapters is in some respects not unlike that put forward in this country by Professor Hayek. Hayek [1] has drawn attention to the unneutral effect of banking action in causing a departure of the rate of interest from the natural rate and points out that this interferes with appropriate movement of the structure of industry to more or to less capitalistic forms of production. But there seems to be no compelling reason why we should accept Hayek's deflationary suggestion that we should keep the quantity of money constant.[2] The inflationary views of Keynes on this point seem in practice preferable, even though they involve an uncritical acceptance of those types of banking activities that are ultimately responsible for the trade cycle itself. Such a policy involves the constant pursuit of the natural rate of interest along lines which continually push the goal beyond our reach and obviously involves the perpetual repetition of the cyclical movement. This may be preferable to permanent depression; and if the trade cycle is ineradicable we might as well relieve the misery of one depression by the wholesale administration of banking stimulants to restore the flagging vitality of

[1] Hayek, *Prices and Production* and *Monetary Theories of the Trade Cycle*.

[2] See Hayek, *Prices and Production*. Even if the quantity of money be interpreted as the quantity multiplied by the velocity of circulation, it is difficult to see why the result should be in any way neutral. I believe this is the only point on which I would seriously differ from the teaching of Hayek on capital and money.

industry even though the aftermath may be an increase in the magnitude of the next cycle. But it is commonly supposed that the cycle may not only be relieved but smoothed out by an appropriately elastic credit policy and by appropriate state intervention in the matter of public works combined with semi-communistic provision of incomes to the special sufferers so far as is permitted by a social system that aims at remaining, in its central features, a system of private enterprise. That this is an illusion seems clear; and such is apparently part at least of the doctrine of Professor Hayek. To clarify this point, let us see what would be the appropriate fluctuation resulting from one of our abnormal influences on the assumption of rigidities even greater than we find in reality.

Let us suppose that all capital is fixed capital of various "degrees of capitalism" and that there are no alternative methods of producing each separate item and development is taking place by the substitution of "more capitalistically" produced constituents of income for "less capitalistically" produced constituents (owing to the elasticities of substitution between constituents of income as total income increases). A new want appears; and this also requires fixed capital. Neglecting the slight increase in labour offered at the same real wage, owing to the rise in the marginal utility of income, labour must be withdrawn from other industries partly by a reduction in the rate of increase of whatever fixed capital is expanding, but also by throwing into idleness some fixed capital, which, but for the new want, would be fully employed. Eventually, the new fixed capital bears fruit in income and the labour applied to its construction and its use diminishes, while some, but only some, of the idle fixed capital comes back into employment and the expansion of certain other kinds of fixed capital is resumed.

Let us now adopt an assumption at the opposite extreme,

that all capital is simple capital but there is only one method of production for each constituent of income. When the new want appears, labour is released by ceasing to produce various amounts of the various kinds of simple capital (according to the various elasticities of substitution of the products and the various periods of production), so that income is not immediately diminished as in the fixed capital example, though future income is diminished as regards at least some of the old items of income. Over one period of production of the new capital, there is, therefore, a shortage of income, after which total income has the appropriate amount of each constituent and development proceeds normally. Instead of a fluctuation, labour and income are jerked into a new equilibrium, from which development proceeds normally.

In so far as actual methods of production lie between these two extremes, an appropriate fluctuation requires some fluctuation in the employment of existing capital; in other words, that fixed capital should, at times, lie idle, and stocks of working capital remain unutilized or even perish.

Fortunately, the rigidity of the industrial system is far from absolute. Less capitalistic methods of production can be temporarily adopted in, at least, some industries, so that the sacrifice of income required for a given liberation of resources for the new investment can be less than would be needed in the absence of flexibility, and the income sacrificed can be spread over a wider future. The amount of new investment is thereby increased, and the loss of utility from future income diminished by a more equi-marginal spread through time. This does not, however, mean that the temporary idleness of fixed capital and/or non-utilization of stocks of working capital are diminished; they may even be increased, for a given amount of labour may, in a particular case, give a sufficiently larger output

of certain products, by a less capitalistic method, over the future period during which labour is more urgently required elsewhere ; while the fixed capital in the industries thus affected, though requiring a less amount of labour to produce the same amount of product by the substitute method, can postpone its demand for labour to a time less convenient from its own point of view, but more convenient for the purposes of industry in general. Now, there is one way of shortening or lengthening the period of production which is always available for non-perishable goods, however complex the use of fixed capital and working capital may be, namely by working at over- or under-capacity and by allowing a diminution or increase of stocks of working capital (including stocks of finished goods). Therefore, an appropriate response to a sufficient abnormal influence requires a fluctuation, both of capacity-working and of stocks, throughout the whole of an industrial system that shows any flexibility in this respect. The flexibility that this gives is even greater than appears at first sight, for stocks may be varied asymmetrically, being allowed to pile up or to diminish at stages near the finished goods end as compared with earlier stages. Now it is at the commencement of the fluctuation that labour is wanted most urgently elsewhere ; therefore, the labour that remains to an industry should be devoted to producing the product earlier and, in general, stocks should be allowed to run down at the raw material end, and the fixed capital used near the raw material end should be the first to be thrown into idleness, until the reduction of stocks at all stages has reached a point where the inconvenience caused by any further reduction outweighs the advantages to be got from further labour transfers. As labour returns to the industry and the rate of interest again begins to fall, the reverse process sets in, and stocks of half-finished goods become high, relative to finished goods, and fixed capital at the raw

material end is employed at fuller capacity than can be the case at the finished goods end. The period of production is again being lengthened, and if the future rate of interest is for a period less than unity (as might conceivably happen in certain extreme cases), stocks even of the finished goods may be greatly in excess of normal requirements, simply because these goods will be more valuable in the future than now. As the rate of interest finally moves to the new developmental level, stocks of the various kinds of working capital again become normal and symmetrical as between early and late kinds, and the use of fixed capital in different stages again becomes balanced. Whether or not there is a return to full capacity depends, of course, upon the elasticity of substitution of this product over against others in the newly-constituted income and on the extent of the consequent change in what henceforth is to be the path of development.

Fluctuations of capacity-working throughout industry and fluctuations in the amount and symmetry of stocks of working capital are thus seen to be an essential accompaniment of all appropriate responses to abnormal influences, and there is no reason to suppose that if we got rid of the trade cycle we should get rid of these particular fluctuations. It is, on the contrary, the attempt to check these fluctuations, that is largely responsible for the cycle. If we observe the behaviour of any typical industry from the beginning of a boom, we are likely to find the reverse of the appropriate behaviour described above. It runs at first at greater capacity instead of less capacity, and later when stocks should be at a minimum and labour returning to the industry, stocks have piled up, fixed capital is becoming idle, and labour is being thrown out of employment. And as the depression continues, the decline of stocks in the actual world is rightly regarded as the herald of recovery (whereas, with appropriate fluctuations, the corresponding phase

would be one of increasing stocks and expanding activity on the part of fixed capital). But, by this time, banking-rates have fallen low, the State has ceased to be economical in its public works programme so that such things as roads and houses are being constructed to yield a distant income though immediate income is rather what is required. Early income, however, as represented by the stock of capital nearing maturity, is being depleted in favour of more remote income, while the growing volume of employed labour is wanting an early not a remote income. Eventually the point is reached when the labour that has been devoted to remote income as compared with early income, attempts to consume an earlier income which is insufficient, bringing about a relative capital deflation; but the rising income price-level associated with a fall in the value of capital (i.e. of long-period capital as compared with short-period and short-period as compared with income) is interpreted by the community as an increased demand for capital. The banking system responds by granting more credits, for industries now require more working capital, and the capital deflation is checked or even turned into a capital inflation. We are now back where we started and another fluctuation is inevitable; and it requires no errors of pessimism or optimism (though these will, of course, magnify the fluctuation) to perpetuate the oscillation for ever, so long as the banking system continues with a credit policy that has any elasticity whatever.

Chapter XIII

CONCLUSION

Traditional economic theory is based on a preliminary assumption about equilibrating disutilities and utilities at the margin. The disutilities are conceived as naturally falling under more than one head: labour, saving (or waiting), risk-bearing (or uncertainty-bearing), or some similar combination. Risk-bearing, which in actuality is interwoven with every form of economic activity, is, in this book, set on one side to give the convenient simplification of a world in which the results of all economic activity are normally fully pre-known, the most striking exceptions (inventions, new wants, etc.), being introduced because of their dominating practical importance. Labour is accounted the sole ultimate factor of production (apart from the free gifts of nature known as land) and it is contended that there is no other independent factor, saving or waiting, which it is either necessary or legitimate to invoke in ultimate analysis. If labour produced only concurrent utilities, economical behaviour would clearly result from the proper balancing of the marginal disutility of labour with the marginal utility of the product, as traditional theory would agree. If, however, the product lies in the future it is here contended that the equilibrating tendency can be in no essential way different, and that it is unnecessary to invoke some other factor called waiting. Instead of the traditional assumption that two disutilities (of labour and of waiting) are somehow combined at the margin and equilibrated with the marginal utility of the product, we substitute what is obviously a legitimate and necessary

implication of the accepted psychological assumption, namely that there is a tendency in human beings to equate the marginal disutility of their labour with the marginal utility of the product, whether that product be in the present or the future. Saving then necessarily emerges in a determinate way out of any economic situation. But there is one qualification of this tendency towards equilibrating utilities and disutilities to which attention has with exceptional emphasis been drawn: that if the product of labour is sufficiently remote, it is an obvious characteristic of human beings to discount its utility, in such a way that, in a Crusoe economy, if in no other, the separation in time between labour and the emergence of its product alters the resulting equilibrium to an extent precisely determined by the specific strength of this discount. In an exchange economy, however, we have argued (in Chapter II) that this consideration may be neglected; for there is no observable tendency to discount the immediate future and exchange possibilities render unnecessary all consideration of the remote future on the part of the saving individual. Given this necessary extension of our psychological basis, the conception of static equilibrum can be extended to include the future, so that we may speak of an equilibrium through time. By this we mean a determinate distribution of labour and income through time similar to that equilibrium arrangement of labour and income at any moment, which follows from the simpler assumption.

Now, static equilibrium implies that if the equilibrium-situation is achieved, then, if we assume the irrelevance of any factors other than those that we have selected when indicating what equilibrium involves, no change in the situation can come about. But if the situation has a time dimension, we have, in addition, the influence of facts that may emerge during the time under discussion; changing wants, new inventions, and so forth. Whenever

we are entitled to make definite assumptions with regard to these emerging facts, there is one and only one equilibrium through time on that particular assumption; whereas on static theory we have only a number of static equilibria depending on these facts and on the saving of each moment and on the results of past saving (or, in other words, the constitution of total wealth at the preceding moment). When, therefore, we speak of equilibrium through time we mean that series of situations that would result from the operation of the tendency to equate the marginal disutility of labour with the marginal utility of income products, the new facts as they emerge through time changing these utility and disutility schedules and altering the direction of activities in ways previously unforeseen. Now, if in the real world new facts appear at such a rate that static equilibrium is never achieved, this in no way reduces the usefulness of the conception, and our theoretical investigations are still investigations into the equilibria which would be achieved, if only time were available before the facts change and point to a new equilibrium. Similarly the conception of an equilibrium through time is not robbed of its usefulness by the impossibility of the equilibrium ever being achieved—either because new unanticipated facts appear which set before us a new equilibrium, or because every departure from equilibrium sets before us a new path to equilibrium (instead of bringing into play forces, as static theory assumes, that restore the pre-existing equilibrium).

Now, static theory can give a precise statement of equilibrium for any system of utilities, disutilities, and resources that it postulates, but it is forced to assume a stationary state in which there is no saving, or else, if schedules of saving are introduced, an endless series of equilibrium positions each prevented of achievement by the influence of the saving itself. If, for instance, we assume

the labour disutility schedules and the income utility schedules of the community and a stock of wealth owned in some given manner, wages, incomes, and ownership of wealth are all precisely determined, i.e. there is an equilibrium output of the various kinds of capital and constituents of income and a given distribution of wages and ownership of wealth, such that any deviation from this scheme compels, on the assumption of perfect competition, restoration of the situation, provided that there is no saving. Once we introduce into our assumptions a schedule of savings-preferences for members of the community, constructed on any plan we like, there ceases to be such an equilibrium, and the supply and demand analysis that enables us to discover equilibrium in the absence of saving now leads us astray by suggesting that equilibrium is given by a price, the rate of interest, which equates supply and demand. The equilibrium which is being studied is not the postulated equilibrium from the viewpoint of static theory but a pseudo-equilibrium. It is that quasi-equilibrium that we have designated equilibrium through time. Further, unless we extend our fundamental psychological assumption in the way suggested, there is not even a quasi-equilibrium, and static theory is under an obligation to admit that when there is saving, the static equilibrium is being destroyed by one of the ingredients of the situation, and no equilibrium can exist until the disturbing element, saving, has been extruded. If, however, there is a tendency to equate the marginal disutility of labour with the marginal utility of the product taken in its fullest sense (covering, therefore, the income appearing in the future), saving is bound to emerge in a determinate manner; instead of occurring to the extent and in the way that equilibrates its own peculiar supply-price with its own peculiar demand-price.

Now, the equilibrium through time which this extension

of the psychological basis of traditional theory thrusts upon us is even less likely of achievement than any particular static equilibrium that we choose for investigation, though there must always be a tendency towards the equilibrium which is constituted afresh after every mistake and every unanticipated fact that emerges, such as inventions and changes in wants. Furthermore there is a conservatism about development that is indicated by the emergence of entrepreneur-profit, though overridden at times by the unneutral behaviour of money alternately accelerating development and retarding it by inappropriate fluctuations. Nevertheless, the underlying determinateness of development can be demonstrated if the situation is simplified in a way which retains the essential features of capital and of the process of saving; and the modifications that will need to be introduced when those simplifications come to be dropped are not difficult to see in general outline.

This process of equilibrium-development we have seen to be one of falling rate of interest, declining rate of investment, and, in general, of saving, declining volume of labour (if population is stationary), rising volume of capital, rising volume of income, and rising ratio of capital to income—all of which are the natural corollaries of the lengthening or growing capitalization of production. But this development is at the same time constantly checked, temporarily, by new inventions and positive windfalls, which subsequently hurry on development, and by negative windfalls, which momentarily slow it down. The creation of new wants (under which head may be placed any increase of population) is also a check, differing from these others in being able to maintain the rate of interest indefinitely at any figure, since there is no obvious limitation on the creation of new wants. As the rate of interest falls the income-values of both capital and labour rise, expressing the increasing productivity of lengthier, i.e .more capitalistic, production and the

increasing division of labour which is usually made possible by more roundabout methods.

On the view we have been stressing investment and, in general, saving [1] is at a maximum when a community is in a state of poverty due to the absence, as yet, of capitalistic methods of production, and saving diminishes as income grows as a consequence of development. Traditional theory does not appear to accept this conclusion, and Mr. Keynes goes so far as to depict at length the horrors of the failure of humanity distressed by an ever-growing flood of saving, needing to be dissipated in an orgy of pyramid-building. In forecasting this as a conceivable catastrophe it would almost seem that he has slipped into the confusion of treating saving as in itself constituting a want (and indeed a dominant want) among other wants, overlooking the obvious truth that if there is any price at all for saving, future income must be expected to be greater, not less, than present income. The wealthier we get in the present only, the more we should save; but the wealthier we get in the present and the future, the less, in general, we should save. Saving is a transfer of income from present to future ("present" being used to cover the earlier future), and is not paid a price unless future income is made greater than present; and as soon as future income fails to exceed present income, the price disappears, saving comes to an end, and a stationary state is achieved.

It is when we come to the theory of distribution that the main difficulties of the traditional method emerge. The national dividend is represented as the combined product of a number of factors of production, each of which has a supply schedule; and the distribution of this total product between the factors is exhibited by static analysis. Now,

[1] It is, of course, possible for the curve of saving to rise considerably before falling below the initial amount, according to the various magnitudes of increased productivity from lengthier methods with their appropriate division of labour. The curve of investment must, however, in all likely cases, show a continuous decline.

if we take a short period of time, there is no difficulty about the supply schedule of labour and land, but what is the supply schedule of capital? Is it concerned solely with the stock of real capital or solely with the saving over the period in question, or is it in some sense the sum of the two? The traditional theory of distribution implies that we can make some exhaustive classification of the factors of production jointly producing the community's wealth, and that they are on the same footing, and that there is no tendency for the marginal disutility of labour to equal the marginal utility of the product. Since no labour exists at a point of time, the traditional theory is forced when illustrating this point to take a period of time (which, however, we can make as short as we like), and if it attempts to estimate the services of the stock of real capital over this period, it seems to be precluded from treating the "service" of saving within the period in the same way as it deals with the services of labour, unless it is prepared to state the share of capital under two distinct headings and to calculate it in two distinct ways. If capital were treated (like land) as a stock throughout the period and the existence of saving ignored, each factor would have a precise marginal product, and the conditions would be fulfilled for a theory of distribution which would be satisfactory if saving had actually ceased. We should be then considering a quantity of labour rendered within this very short period, a quantity of services rendered by the stock of capital, and a quantity of services rendered by the stock of land. Since each of these factors will have a determinate marginal product, each will take a share of the total product in the form of wages, quasi-rent, and rent. No inconsistency shows itself provided that, at the end of the period, capital is found to be unchanged. In such a case we should expect to find the marginal disutility of labour equated with the marginal utility of the product, and to find (in the absence of

effective discount) that the share of capital is zero [1] (as argued in Chs. III and IV). If, however, the quantity of capital is changed, the increment of capital is part of the combined product, while a new factor, a quantity of saving, needs to be taken into account and a new difficulty emerges in assigning its marginal net product.

The argument of this book is that when saving is taking place income is being postponed to the future as a consequence of previous decisions to lengthen the processes of production. The period extending from the moment when income which would have appeared but for these decisions ceases to appear to the moment when the future substituted income begins to appear, is the period of saving. Investment, on the other hand, is the actual process of applying labour to the lengthier method instead of to the shorter, so that saving and investment are two aspects of one and the same complex adjustment, and investment necessarily precedes the saving which it implies. This is most clearly seen when we think of all capital as being what we have called Simple Capital. When capital is complex, this process—investment followed by saving—normally means that the distribution of saving and investment also becomes complex, and also that the capital is changing from one complex form to another. In the case of fixed capital there is a continuing investment and disinvestment that is never complete, except when we have fixed capital that it is intended to discard or which comes to be discarded owing to mistakes or new inventions. Therefore, whenever we have a growing stock of fixed capital in use, there is a complex process of saving and dis-saving, investment and dis-investment, taking place. When the decision to produce and use fixed capital is made, a decision is made to allocate saving and investment in a certain way, so that

[1] It would not be zero, of course, if monopolistic policy prevented further capital production, but only if under competitive conditions there was no effective inducement to capital production.

labour after the initial period of construction is less than it would be for a given simultaneous income if the capital had not been constructed, labour becoming redistributed through time in such a way that though it may initially be increased, it will later be diminished. In other words, the whole process of investment can be regarded as one of investment during construction and dis-investment over the more distant future. The dis-investment means that labour which would otherwise be required for producing this income is reduced and the liberated labour rendered available for investment elsewhere (this service being normally liberated for the lengthening of the period of production elsewhere). But for the possibility of this lengthening of the period of production of other items of income (e.g. further production of the fixed capital the use of which has created this dis-investment) both dis-investment and saving would come to an end, and the fixed capital would be producing an amount of income per day equal to the income-value of the labour applied to it, and the services rendered by it would receive no reward.

If, therefore, a stock of capital and a quantity of labour, each competing for full employment, co-operate in the production of a combined product, we cannot explain the share which each gets by reference to the marginal product of each; for the only share of the product that old capital receives is a consequence of the rate of formation of new capital. If we introduce another factor of production, saving, the distribution theory can only be formally preserved if we are prepared to assert that real socially effective saving can appear which is not determined by the same past decisions that have caused the stock of capital to take the particular form that it has at the moment. The possibility of their being any appreciable "saving" of this nature in a developed community it has been of one of the chief aims of this book to rule out as inconceivable.

As regards the problem of wages we have, at the one extreme, the Marxian view that interest is a surplus created by labour which, therefore, does not receive its full reward, and over against this the traditional marginal productivity theory. We have argued that while the community is in process of adopting lengthened methods of production those who take up the new methods before they are universalized receive what may reasonably be described as a payment for saving; but when the new method has been adopted fully over the whole field the gain takes the form of a "surplus" added to wages. In certain respects, Marxian theorizing shows a deeper insight into the functions of capital than is shown by the traditional marginal analysis, when it insists that the ownership of capital as distinct from saving should receive no reward. For interest is in ultimate analysis, not the price of roundaboutness as such; it is the necessary price for increasing roundaboutness; but if roundaboutness merely calls for maintenance with no observable possibilities of increase in some fields, the fact that capital can (in a sense) be transferred from one field to another, means that, if in some of these fields an increase of roundaboutness is in process, interest payments in all fields are necessitated. Unlike all other prices it is the price of a change, which is why static equilibrium theory can give no consistent account of it. If interest is the price of saving, and saving is bound up with the lengthening of production, then, when the lengthening of production ceases, saving ceases and its price falls to zero, the owners of capital retaining no special advantage other than the power to dis-save that the ownership of wealth necessarily confers. If in such a stationary state we found that there were still interest payments (including quasi-rents) this would seem to indicate that capital, as such, must be rewarded, rather than the service of increasing it; and in such a stationary world it would be reasonable to argue that all interest constitutes a tribute (or surplus)

payable to the capitalists, for total wages are lowered by precisely the equivalent of the total of interest payments. Since, however, a similar situation could continue to exist even in the stationary state if the future were effectively discounted, we have a possible explanation of the way in which the Marxian paradox may have arisen, as well as of the attempt to import into static theory a supply and demand analysis of capital and interest.[1] But in any state that is not stationary, interest is bound to be to a considerable extent the price of lengthening the period of production, even though a positive but very much lower price would at the same time be necessary if there were effective time-discount to prevent the collapse of the capitalistic structure to a state in which all labour is direct and capital non-existent.[2]

[1] These criticisms of the traditional treatment of the problems of interest do not apply to the method adopted by Professor Pigou in *The Economics of Stationary States*, where interest is always the same thing as discount, which Professor Pigou assumes to be effective.

[2] Since interest is the price of lengthening the period of production, then, when the new structure has been built up, no price should remain for saving. But when in one part of the system a structure of production has been built up and there is no further lengthening, although there is a lengthening of production elsewhere, capital continues to be rewarded. This is because, so long as production is being lengthened elsewhere, resources could be drawn from the first structure by shortening it again (i.e. by allowing the structure to collapse), and a payment must be made to prevent this; so that interest is the price of not dis-saving as well as the price of saving in a community which is developing. The interest which emerges as a result of development is, therefore, in part the analogue of interest maintained by time-discount in a stationary state. In the latter there is no saving, and interest (if we conceive of interest being paid) is entirely the reward of not dis-saving. This aspect of interest seems to have been ignored by those who are wont to describe it as the reward for abstinence or waiting unless they believe that there is abstinence or waiting in the stationary state. It might, however, be regarded as the penalty for non-abstinence when some members of a stationary state have a higher time-discount than others, enabling the latter to secure an income without work by taking advantage of the weakness of the former. If the poor have a high time-discount and the wealthy a low there could be an unequal distribution of wealth which would lead to permanent poverty for the one class and luxurious idleness for the other. Precisely the same situation arises during development, even if there is no time-discount; for capitalists are paid both for saving and for refraining from dis-saving and the latter process involves no abstinence or waiting. It is the necessity of paying for not dis-saving as well as for saving which is one of the disadvantages of individualist societies

Accordingly, even on the assumption of time-discount, interest is only in part a drag upon wages, since it is also largely paid out of the continuous incrementation of income resulting from saving. Nevertheless, just as time-discount if it could be effective raises the rate of interest both in the stationary state and during development, there are also other factors that slow down development and raise the rate. Inheritance, the arbitrary ownership of land and similar socio-legal institutions—between them constituting a group of features that (in combination with some of their natural offshoots, of which entrepreneur-scarcity is the most prominent) are frequently referred to under that omnibus heading, the " class structure "—all tend to check the fall in the rate of interest, so that wages are prevented from rising, and capital may be said to be rewarded at the expense of labour to the extent to which wages are lower than they otherwise would be. In such a " class society " interest may, with some justification, be regarded as a surplus, created by labour, only part of which is allowed to benefit labour, since much of what they forgo fails to bring its appropriate harvest owing to the retardation of development which results from the social structure. But even this is to say no more than that the value of labour (given the facts of human productivity and inventiveness and the amount and nature of the natural environment) is simply dependent on the rate of saving and on nothing else. Nevertheless, this proposition gives us a measuring rod for discovering

since it unduly promotes anti-social activities likely to maintain a rate of interest.

The " surplus " nature of interest is perhaps most readily seen when we unduly simplify our picture of production—a stock of capital being maintained, which requires the " service " of not dis-saving, and a volume of new capital coming into existence that requires the service of saving. Interest rewards both these services, but only the latter service is increasing the productivity of labour, and therefore interest for not dis-saving as distinct from interest for saving can be looked at as a surplus, created by labour, and levied as a kind of blackmail by the owners of capital for not dissipating it; so that " not dis-saving " has as much right as " saving " to be accepted as a synonym for capital.

the imperfections of any given social organization. For instance, in a capitalist society, we find that inheritance tends to the dissipation of fortunes, and, therefore, a reduction in the rate of saving; we find that the rising value of land acts in the same direction, both during the lifetime of an owner and even more, through inheritance; the consequent "class-structure" of society, through its effects in the scarcity of entrepreneurs and other highly skilled types, also reduces the rate of saving through the delay in adoption of lengthier methods, and the evil of monopoly is to be assessed not only by reference to the maldistribution of income and of the factors of production that accompanies it, but also by reference to the further consequences of these in reducing the rate of saving. And, finally, in a capitalist society, new wants that would never appear in a classless society emerge in such a way as to reduce greatly the rate of saving as compared with what would occur in a classless society.[1] The theory of wages in its broadest aspects cannot, therefore, be treated apart from the theory of saving. The operation of a fundamental psychological law leads to a determinate rate of saving, and a determinate value of labour in terms of income, at any moment, given the facts of productivity and wealth-ownership at that moment. There is, therefore, a determinate rate of change in the income-value of labour, capital, and land at that moment. This is given by the theory of development, which may, thus, be regarded as a theory of distribution in the only sense in which it is possible to have a theory of distribution. But the rate of saving is affected by the social structure; and the movement in the income-value of labour, capital, and land is determined only when we have assessed the importance of this effect. Only if the state has become a stationary one is there a theory of

[1] This important point is brought out clearly by Dobb in *Wages*, p. 102. Competitive expenditure is an inevitable accompaniment of societies with a class structure, and, therefore, the rate of saving is diminished.

distribution (i.e. of wages, interest, and rent) in the orthodox sense.

Orthodox theory takes for granted the schedules of wants, willingness to save, and willingness to work, and assumes that any of these may change or new methods of production be discovered without the introduction of any additional difficulty for such a treatment, the values of the factors of production when there is a change in any of these constants is just as readily given as before, and, if the values of the factors are known before the change in any of the constants is introduced, the change in values is, so it is assumed, precisely given. For example, a new invention increases the demand for saving and there will be a consequent rise in its price, the extent of the rise depending on the shape of the new demand schedule for and the old supply schedule of saving. This analysis is pushed one step further by Pigou, when he distinguishes between inventions which are labour-saving and inventions which are capital-saving. If we mean by a capital-saving invention an invention which leads to a smaller ratio of capital to labour in the industry concerned (a more restricted definition than that adopted by Pigou), then no invention can be capital-saving from the point of view of industry as a whole.[1]

[1] A new invention might conceivably affect the whole productivity-schedule of the series of more roundabout methods in the industry directly affected so that in the stationary state the ratio of capital to income in this industry would be less than would have been the case but for the invention. The invention might, in such a case, be described as " capital-saving " from this ultimate long-period point of view (when, that is, we look forward to the final achievement of the stationary state), since the ratio of capital to labour throughout industry as a whole would then be less than would otherwise have been the case. (Less capital in proportion to labour is required for a given output in the industry directly affected. The development of other industries has been hastened, but their ultimate structure is unaffected ; and so in the grand aggregate of industry the proportion of capital to labour is lower, unless the substitution of income-constituents for one another interferes, than if no invention had appeared.) It should be remembered, however, that, during development, owing to the setting free of labour for use in the rest of industry that hastens the adoption there of more capitalistic methods, capital is expanding at a greater rate than would have been the case but for the invention, which must prove to be labour-saving from the point of view of development.

If, after allowing for substitution of constituents of income for one another, we admit the possibility that the structure of production can be rendered less "capitalistic" as a whole (whether because the particular industry becomes less "capitalistic" or because the substituted demands are for products less "capitalistically" produced) we must be failing fully to benefit from the invention by a failure to equate the marginal disutility of labour with the marginal utility of the product. A new invention can scarcely bring about dis-saving and disinvestment on balance,[1] since the appropriate changes by which the period of production can be lengthened are always available for adoption, and the invention must on balance prove, therefore, to be labour-saving. The rise in short-period rates of interest that accompanies the first progressive adoption of the new method is not the result of a new equilibrium of the supply of saving and an increased demand, enabling us to exhibit the change in values of the factors; for this would imply a schedule of the supply of immediate saving, with, presumably, some elasticity, whereas saving at any moment is completely inelastic,[2] since it is only the volume of future saving that can respond in a community producing capitalistically. But investment can respond by changing its direction, and with it the volume of future saving. Labour,

[1] I.e. this theoretical possibility is so improbable that it may be neglected.

[2] The non-neutrality of money (as this term is used in this book) makes this in part untrue in the actual world. As Mr. Alston has pointed out to me the savers have been clinging to money and raising its value in such a way that, owing to the existing rigidities of the economic world, some labour and even some fixed capital is forced partly out of action, thus creating a reserve of idle resources. The demand for saving overcomes this decision to "lack" and allows the labour to come back into action with the natural result that if this process were an inevitable feature of the economic system, it would almost be excusable to treat a "demand for saving" as a "demand for money" and elevate money to the position of being virtually a factor of production. This way of thinking about money is probably dominant among men in the street, and its influence can be perceived in popular writers on money when, for example, they use such phrases as a "shortage of circulating capital" or speak of the public "holding back resources from investment".

therefore, when an invention appears, is applied to the production of the new capital at the expense of producing other kinds : there is, in other words, a process of disinvestment, accompanied by changes in the day-to-day rate of interest (which, in the typical case, moves first upwards, then downwards, and finally upwards to a level slightly below the rate that would have ruled but for the new invention), causing a fluctuation in the structure of production such as necessarily accompanies any unanticipated change in the situation, owing to the persistent tendency to equate the marginal disutility of labour with the marginal utility of the product. The traditional analysis reaches the conclusion that when there appears a more productive method of producing income, the desire for which has not changed, the demand for saving is increased ; and, the supply being elastic, more saving is forthcoming ; but as this is necessarily paid a higher price, a smaller share of the national dividend is left to go to labour, the value of which falls, at least until the national dividend is eventually increased. There will, therefore, be a decrease in the supply of labour if there is any elasticity of supply. If this were true, we could have a new invention of magnitude sufficient to reduce the supply of labour to the point at which it becomes completely inelastic. If, moreover, a still lower price could render the supply negatively elastic, an invention of greater magnitude could by further lowering the price raise the supply to any conceivable extent.

Pursuing a perfectly correct method, but on a doubtful psychological basis, orthodox theory has given an account of the formation of particular values, whether of particular forms of labour or of particular goods, concerning the correctness of which there can be little ground for dispute in all cases where the items considered are negligible parts of the total. It is only when we consider output as a whole,

or the general theory of distribution, that the method leads (we believe) to incorrect conclusions. Partly this is due, we are inclined to suspect, to an incomplete theory of money. The traditional marginal productivity theory of distribution, equally with the theory of this book, involves the existence of units of the factors of production which are definable without the need of presupposing a valuation, if the purpose of the theory be the explanation of all resultant values. If, however, both capital and income are dealt with by some such treatment as ours, which defines for each a clear quantitative unit, this difficulty is overcome. The theory of development of relative values of capital, income, and labour appears, then, to require no importation of some independent valuation for the purpose of defining the units valued. The attempt of Mr. Keynes to handle units of capital without reference to a valuation, appears to have failed; for if a quantity of capital can be said to increase, it is necessary for the increment to contain a definite number of units of the quantity that is increasing, and this is denied by implication; so that, if a change in a quantity of capital could be described as an increase, we should necessarily be able to state the quantitative relationships between every complex of capital in existence; a notion that Mr. Keynes openly rejects. But none the less he seems to cling to the idea that the value of an increment of investment is the value of a quantitative increase of capital. Marshall's treatment may appear not to be open to any similar criticism since he speaks of capital as if it were the embodiment of two discrete quantities, labour and waiting; but this gives us the unfortunate result that no piece of capital is related in a simple quantitative manner to any other unless it happens to embody labour and waiting in the same proportions in each case. The usual method of escape from this dilemma is to make the unit dependent upon a money-value, and to assume for purposes of distribution

theory that money remains in some way a non-disturbing (or neutral) feature of the system—a lubricant, as it were, that reduces friction without itself being a source of friction. Since this has often been taken to mean that it retains some constant valuation, such as a constant average value in terms of income goods, it has come to be felt that money can only be a non-disturbing element, either in theoretical reasoning or in the business activities of the community, if its " value " is unchanging ; and this feeling may account for the importation of the study of index-numbers into pure monetary theory. A money of " unchanging value " may offer temptations as a substitute solution of the problem of finding quantitative units of capital, but such a money would not be the " lubricant " that the theory of development demands.

The construction of a self-consistent theory that explains changes in the relative values of such things as capital, income, and labour without the necessity of the units being defined by reference to something the value of which remains " neutral ", allows the theory of money to be set alongside this as a theory of the modifications of development and values that result from the use of money in any particular social organization. In any pure theory of economic development frictionless perfection of exchange needs provisionally to be assumed, and this calls for some reference to money as a medium of exchange. It becomes important, therefore, to discover what are the requisite conditions for monetary neutrality in the sense of the absence of any distortions resulting from the use of money, the most important of these distortions being changes in the relative value of capital goods in general, on the one hand, and of income goods and labour on the other. The meaning of neutrality is unambiguous on this view ; but any theory of the relative values of the factors of production which introduces monetary valuations into the definitions

of the units and requires that the standard of valuation should be " neutral " in some different sense is confronted with insuperable difficulties.

In the usual approach to this question insufficient care seems to have been taken in distinguishing any unneutrality which may result when money is used as a medium of exchange from that which results from its use as a standard of value for contracts. It is important to recognize that money need not be neutral, even in a non-contractual society; and, since it must, in practice, be held and cannot circulate with infinite velocity, it is of the nature of money to be unneutral in any developing community and could only be neutral in a stationary state. But, approximate neutrality, sufficient for our purposes, is achieved in a non-contractual world if the quantity of money remains constant, or if, when variations occur, it is made to vary in the hands of holders of it in proportion to their money-holdings. For, if the quantity of money remains constant or varies on the above plan, those who alter their holdings in one direction will not be biassed in favour of purchasing or selling goods in a different way from those who alter their holdings in the opposite direction, since the reasons for the changes of relative demands are reasons of exchange-convenience only. Since both the selling of money is equal to the buying of money, and the selling of goods equal to the buying of goods, the most probable result is one in which there are no changes of relative values consequent on such changes of relative demands; and even the most improbable result will be no more than a slight haphazard dispersal of the prices of individual capital goods and income goods, the change in the prices of some balancing opposite changes in the prices of others, though the money-value of all items of wealth taken together may, at the same time, change to any extent.

If, however, a banking system alters the quantity of

money, or money is hoarded (which, however, we need only consider in a contractual world), the bias of those who increase their holdings may well be different from that of those who decrease their holdings, and there will be an inflation of one set of values relatively to the other set, however values as a whole may move. Since the banking system is completely biassed in favour of buying and selling capital, it follows that whenever it sells money it causes a relative inflation of the value of capital as compared with income, and the contrary whenever it buys money, and this occurs whatever movement in total prices accompanies this action. The same applies, whenever there is hoarding or dis-hoarding on the part of any member of the public, since the reason for the hoarding or dis-hoarding is a bias in favour of capital or of income which is likely to be different from that displayed by other members of the community. It is this fact which has brought into prominence the conception of " forced saving ". Unfortunately, this term has given rise to some misconceptions; for dis-hoarding or hoarding involves no change in the total of real saving, only a redistribution of this real saving among the members of the community, some of whom are induced to " save " while others are induced to " dis-save " to an equal extent. But capital inflation produced by banking-action (inflation of capital in terms of present income) is an inflation of the value of future income in terms of present income, or, in other words, a fall in the rate of interest. This will mean that labour will tend to be employed in more roundabout ways, so that it seems permissible to speak of forced investment and, therefore, of forced saving in the future. If we call that rate of interest which would have been achieved, without the banking inflation, the natural rate, then the capital inflation involves a fall of the rate of interest below the natural rate, which thus enables us to distinguish between a capital inflation expressing a fall in the natural rate from

a capital inflation due to the unneutral behaviour of money. When the rate of interest has fallen below the natural rate, early income is being sacrificed for late income to a greater extent than would have been the case if the natural rate had held, so that the natural rate, on the basis of the new structure of production which is being achieved, eventually rises still higher and further credit can be created only by holding the rate still further below the natural rate, i.e. by creating a further capital inflation. The divergence between the two increases at an increasing rate. The situation must eventually become impossible, and the reasons are not far to seek. There is a natural rate of saving, arising out of the tendency to equate the marginal disutility of labour with the marginal utility of the product. In so far as this rate of saving is disturbed by a fictitious promise of a greater product in the future, it brings its own nemesis. The lower rate of interest in the near future implies a higher rate in the more remote future. The more we lower the rate now and maintain it low the more we raise the natural rate at a later date. The more we invest in longer methods, the greater will be the rate at which the future fruit eventually emerges and therefore the greater the fall in the value of the fruit as compared with the less abundant early fruit. We have not, by means of a rate of interest lower than the natural rate, created a structure of production which, by continued application of less labour at one end, merely bears an increasing fruit at the other end; we have incidentally telescoped the structure so that an abundant income appears over a certain future stretch, while the graduated capital required to maintain an even flow of income through time is missing. We have altered the distribution of investment and of saving through time so as to give an uneconomic distribution of income; we have produced no appreciable effect on its amount. If the rate of interest is equal to the natural rate, a structure of

production is developed, which gives that most economical distribution of the by-products of this structure, known as income. A divergence of the rate of interest from the natural rate has a concertina-like effect on this structure, and produces its own nemesis by the tendency of this structure to be restored. A banking system, if it alters the quantity of credit on any other plan than that of a savings bank that expresses the desire of the community to invest, inevitably disturbs, therefore, the whole equilibrium of production, and generates a tendency to oscillation even in a non-contractual world; and this is quite independent of alterations in the value of money, which are completely irrelevant. If, owing to new inventions, or for any other reason, the structure of production and the natural rate of interest undergo a fluctuation, the disastrous results of banking policy will, of course, be even greater; for it is when the natural rate of interest rises to bring about the appropriate combination of investment and disinvestment, that the banking system intervenes to meet the increased need for accommodation so that the rate of increase in the divergence between the rate of interest and the natural rate will be all the greater.

When we pass to the actual world of contract, it is obviously impossible to have a neutral monetary system, unless we abolish all but one type of contract, owing to the continuous divergence of values from one another in the course of development; and, if we keep even one type of contract, it becomes necessary to deal with the monetary units in such a way as to maintain the constancy of the one money-value included in the contract. This, unfortunately, has usually been interpreted to mean the stabilization of commodity prices, or else a gently rising price-level to lessen the burden of debt, or else a gently falling price-level so as to stabilize the value of labour. Although the last-mentioned would be desirable if the debt contract could

be abolished, it is obviously undesirable so long as this is impossible, but it is, at least, based on a reasonable intention, whereas a policy of a stable income price-level seems to have no theoretical justification whatever, and also implies that there is some average of prices of income goods, which is implied in the making of contracts. If, on the other hand, the object of this policy, or the policy of any given movement of the price-level, is to counteract the effects of what I have called debenture inflation, it appears to be based on the confusion that it is divergences between the expected and the realized real incomes connected with loan-contracts (which have sometimes been called divergences between the money rate of interest and the "real" rate of interest) that are responsible for unneutrality, the supposition being that if we make a contract to lend for a year at 5 per cent the contract is fulfilled only if we receive $\frac{105}{100}$ times as much in income-goods at the end of the year as we lent at the beginning. That this supposition may often lie behind the loan-contract is not denied; but to arrange for its fulfilment is not to neutralize money, and if the rate of interest changes within the period of the loan we must deliberately arrange for its non-fulfilment if we are to prevent a divergence of the rate of interest from the natural rate. Stabilizing the commodity-value of money, in order to preserve equality of the money rate and the so-called "real" rate compels a divergence of the rate of interest from the natural rate, if the latter is changing. When in a credit cycle the money rate of interest and the "real" rate of interest diverge, it is not this divergence which accentuates the cycle—on the contrary, it is a mitigation, and retards the divergence between the rate of interest and the natural rate. Therefore, in a developing community in which the day-to-day rate of interest must be moving up and down, as the new inventions and new wants and windfalls become effective, the neutralization of the effects of loan contracts

can only be achieved if we have an unstable real income for the bond-holders, and is only completely achieved if we neutralize the rate of interest expressed in the loan contract by stabilizing the money rate of interest (as expressed in our accountancy units), even if this involves an instability of commodity prices (whether expressed in " accountancy " or in " concrete " units).

Since, as a matter of fact, the policy of stabilization of income price-levels appears to be gaining the day and the quantity of money required for this is injected by means of the banking system, it would seem that present-day monetary systems achieve a degree of unneutrality, which could only be surpassed by an orgy of inflation or deflation.[1] For we add to the capital inflations and deflations brought about by credit creation and credit destruction the further consequences of debenture inflations and debenture deflations with the further distortions of the values of capital proper that are thereby brought about; and short-term rates of interest, which, in a community developing new wants and inventions, ought to exhibit the greatest diversity among themselves, and should also be constantly on the move, are smoothed out by banking considerations and fail to have any correspondence with natural rates. The consequent confusion of investment and confusion of employment is interpreted as a sign that banking policy and state investment are required to put things straight; and this is likely only to make matters worse by creating further divergences between the rate of interest and the natural rate.

Two main conclusions seem to follow. Firstly, banking as such must be recognized as an evil; and any necessary variation in the quantity of money be brought about by a neutral method. This offers little difficulty, for all we

[1] Though the last cycle in America, as well as elsewhere, has exceeded the pre-War cycle in severity, the income price-level has shown a much smaller fluctuation.

require is that the quantity of money should vary in the possession of holders of it in proportion to their desires for such holdings; and this can be attained approximately by altering the rate of exchange between the medium of exchange and the standard of value, the use of which must be enforced for all contracts. A savings bank must replace other banks, deposits receiving an appropriately changing rate, so that all hoarding of money is replaced by the holding of such deposits. This will enable the bank to vary the quantity of cash-deposits, by purchasing securities when time-deposits increase, and by selling securities as time-deposits diminish, thus ensuring the absence of any inappropriate capital inflation or deflation. Secondly, fluctuations in the money rate of interest must be neutralized by the appropriate treatment of the loan-contract (i.e. by appropriate alterations in the rate of exchange between contractual money and ordinary money as suggested in Chapter XI).

The claim is put forward that at least this proposal has the merit of extreme technical simplicity. It involves, of course, the substitution of a State savings bank for the present banking system and renders obsolete much of the intricate machinery of the money market; but this, according to our thesis, is responsible for the perpetual instability of the economic world. It clashes neither with the fundamental ideals of the socialist nor with the underlying convictions of the believer in private enterprise. Essentially it is a device to enable the true intentions of all individuals, instead of being helplessly swamped beneath the tidal waves of alternate boom and depression, to have their due and proper weight, their desires either to invest or to labour being no longer thwarted and stultified by forces that have escaped society's control.

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